CANADA
DEPARTMENT OF MINES
GEOLOGICAL SURVEY BRANCH
HON. W. TEMPLEMAN, MINISTER; A. P. LOW, DEPUTY MINISTER;
R. W. BROCK, DIRECTOR.

A RECONNAISSANCE

ACROSS THE

MACKENZIE MOUNTAINS

ON THE

PELLY, ROSS, AND GRAVEL RIVERS

YUKON, AND NORTH WEST TERRITORIES.

BY

JOSEPH KEELE.

OTTAWA
GOVERNMENT PRINTING BUREAU
1910

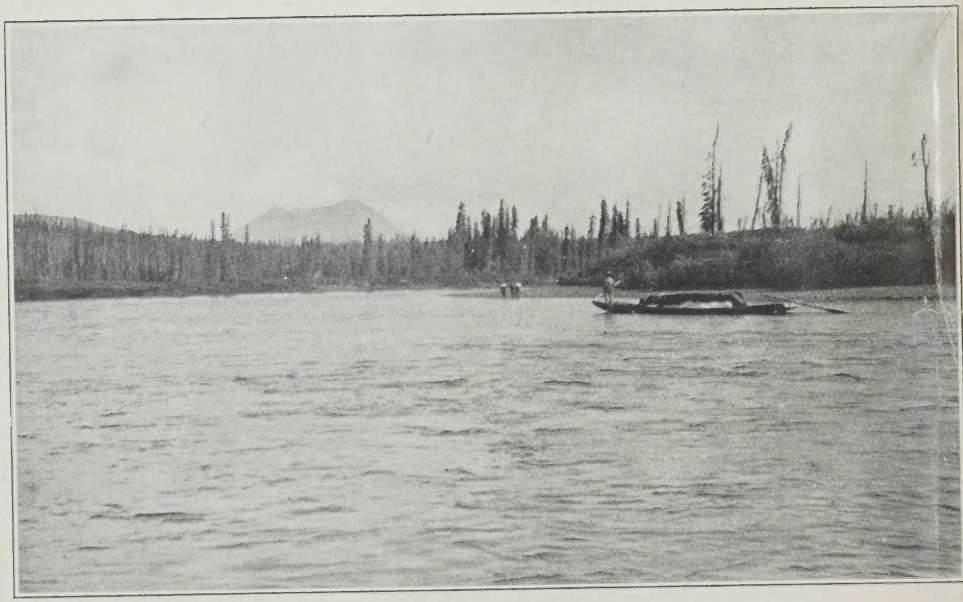
No. 1097

Frontispiece.

PLATE I.

Wolf Cañon, Pelly River.

PLATE II.



Ross River, below Rapids.

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5419—1

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OTTAWA, April 27, 1909.

To R. W. BROCK, Esq.,
Director Geological Survey,
Department of Mines.

SIR,—I beg herewith to submit a report on an exploration across the Mackenzie mountains in the Yukon, and North West Territories.

The report is accompanied by a map and photographs for illustration.

I have the honour to be, sir,
Your obedient servant,

(Signed) J. KEELE.

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A RECONNAISSANCE
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ON THE
PELLY, ROSS, AND GRAVEL RIVERS

BY
JOSEPH KEELE.

INTRODUCTION.

The present report is based on the results of investigations made during a portion of the years 1907-8, in the mountain region lying between the Pelly and Mackenzie rivers.

Since 1897—the year following the discovery of gold in the Klondike—field work has been carried on in the Yukon territory by various members of the Geological Survey. This work has, hitherto, been confined principally to the areas where active mining was in operation, and these have been described more or less in detail.

Owing to reports brought in from year to year by prospectors and others concerning minerals in the outlying districts, a more extended knowledge of the territory seemed desirable, hence I was instructed to examine the country in the vicinity of the upper Pelly river, and subsequently carry on an exploration across the mountains to the Mackenzie river.

I was accompanied throughout most of the journey by two residents of the country engaged at Dawson: namely, R. B. Riddell, and J. M. Christie. It is impossible to speak too highly of the services rendered by these men; suffice it to say here, that owing to their skill, energy and foresight, an expedition, which in less capable hands was liable to be attended by disaster at any stage, was carried through in safety and comparative comfort.

Through the courtesy of the Yukon government, the services of Mr. Robert Henderson—assistant to the territorial mining engineer

—were placed at our disposal during the summer of 1907. Mr. Henderson did some careful prospecting, and collected specimens on the Pelly, Hoole, and Ketza rivers, and on several creeks.

From July 1, 1907, until July 20, 1908, was spent in the field, only a portion of this time being spent in actual survey work. Inactivity through stress of weather; the labour incident to travelling through a mountainous country, and the necessity of procuring a portion of our food from the region passed over, consumed the remainder of the time.

The early part of the summer of 1907 was devoted to an examination of the main Pelly, for a distance of 140 miles above its confluence with the Ross river; the object being to gain a knowledge of as much of the topography and geology in that direction as time permitted; also to inquire into the truth of a report brought down by some trappers of the existence of an active volcano in that region, and if possible to trace out the Pelly river to its source.

After overlooking the region from several mountain tops, and examining the bed-rock and stream gravels for evidence of recent volcanic rocks, the conclusion was forced upon me that there was no truth in the statement.

The course of the Pelly river could be traced for a considerable distance beyond the point at which I turned back, and up to which an actual survey was made. Afterwards, during the winter journey, the source of what is believed to be the main Pelly river was seen from a hill near the head of the Ross river, the drainage being placed on the map provisionally, according to these observations.

Before setting out on the journey, it was decided to use the Ross river—one of the main tributaries of the Pelly—as a route most likely to lead across the summit of the Mackenzie mountains to the head-waters of the Gravel river, which flows into the Mackenzie. This surmise subsequently proved correct; for, after following the Ross river nearly to its source, a gap was found in the mountains, about five miles in length, and containing the divide. After passing through this gap a small stream was found at its northeastern end, which proved to be the extreme head of the main branch of the Gravel river. The unnavigable portions at the heads of the Ross and Gravel rivers and the divide, were passed over during the late winter; the necessary outfit being hauled on sleds by three dogs, in relays—the distance being about 100 miles.

We were entirely thrown upon our own resources after leaving the mouth of Ross river. During the journey we built two boats and one cabin, and, until the Mackenzie was reached, saw no person except a small band of wandering Indians at the head of the Gravel river.

This report is to be regarded only as a first contribution in a study of the geology and topography of the Mackenzie mountains, from observations made on a single line across their greatest width. The method by which the survey was carried on varied with the conditions and exigencies of travel. A micrometer and compass survey was made of the portion of the Pelly river examined, together with sketches from transit bearings on some of the mountains along its course.

The survey of the Ross river to Lewes lake was made by estimating or pacing distances along the river bank, and compass bearings.

From Lewes lake to our spring camp on the Grand river, the distances were measured by a 100 foot steel tape, and compass bearings; sketches, and bearings on prominent mountain peaks with the transit, being taken at intervals.

The Gravel river was surveyed partly by micrometer and compass, and partly by estimated distances; but in addition to this, mountain peaks were occupied at intervals of six to ten miles along its course, from which sketches of the neighbouring country were made, using transit bearings.

Differences of elevation were measured by careful readings of two reliable aneroid barometers.

On the map that accompanies this report, the Pelly river from Ross river to Campbell creek was taken from Dawson's survey in 1887; and the portion of the Mackenzie river shown is from Ogilvie's survey of 1888. The Macmillan and Stewart rivers are from surveys made by the writer in 1902 and 1905. Where the streams are shown by dotted lines, the drainage is known to exist; but has not been surveyed.

Only such features as can be shown on such a small scale are placed on the finished map, a fairly comprehensive idea of the relief of the region being expressed by means of approximate contour lines placed at vertical intervals of approximately 500 feet. The map is by no means an accurate one; but it will prove a reliable guide for the use of future travellers in that country.

HISTORICAL.

In 1887, Dr. G. M. Dawson[1] made a journey from the Stikine river to the Yukon, following the Liard, Frances, and Finlayson rivers. Crossing the Pacific-Arctic divide at the head of the latter river, he reached the banks of the Pelly a few miles above the mouth of Campbell creek, and descended that river to the Yukon.

In Dr. Dawson's report is an account of the first exploration of the Liard and Pelly rivers in 1840, by Mr. Robert Campbell, of the Hudson's Bay Company. Mr. Campbell named the Pelly river after Sir H. Pelly, a governor of the Company, and the Ross river after Chief Factor Donald Ross.

In the winter of 1893, Mr. Warburton Pike[2] crossed from the Liard river to the Pelly lakes, by way of the west arm of Frances lake and Ptarmigan creek. When the spring opened he descended the Pelly and Yukon rivers to Bering sea. The published account of his journey contains a map of the Pelly lakes and vicinity, and a short account of the geology by Dr. Dawson, based on rock specimens brought out by Mr. Pike.

The years 1897-8 saw great numbers of people—attracted by the newly discovered rich gold-field of the Klondike—travelling over various routes to reach that desirable goal. Owing to a defective knowledge of the geography of the country, many attempted to reach that field from the valley of the Mackenzie. Of the thousands who chose that route, several died, the greater number turned back, but a persistent remnant filtered by various passes through the mountain barriers into the Yukon country. Of the latter, was a party which started from Fort Norman on the Mackenzie river in the month of November, 1897, hauling their outfits on sleds, under the guidance of an Indian. They followed the Indian trail to the Gravel river, and went up the Twitya river to the divide. After crossing the divide they followed one of the branches of the Hess river, reaching boating water on this stream in April, 1898, and descended the Hess and Stewart rivers to the Yukon. Little was learned from their experience besides tales of hardships endured, except the fact that they crossed the divide through a low pass containing several small lakes which were at least 1,000 feet below timber line.

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1 G. M. Dawson. The Yukon district and British Columbia, Ann. Rep. Geol. and Nat. Hist. Survey of Canada, Vol. III., Part I. B.

2 Warburton Pike. Through the sub-Arctic Forest. Edward Arnold, London, 1896.

During the season of 1902, Mr. R. G. McConnell[1] and myself made a reconnaissance survey of the Macmillan river and a portion of its main branches, to within about eighty miles of its source.

In 1905, I[2] explored the Stewart river as far as the Tasin mountains, and during the same year Mr. C. Camsell[3] crossed the divide and surveyed the Wind and Peel rivers.

Previous to the present exploration nothing was known of the upper Pelly, the Ross; and Gravel rivers, and the great area which they drain.

Some of the early explorers who travelled down the Mackenzie, noted the mouth of the Gravel river in passing, but there is nothing more concerning it in their journals, with the exception of Mr. A. H. Murray,[4] of the Hudson's Bay Company, who mentions it as a probable route from the Mackenzie to the Yukon waters. He, however, ascertained from some Indians who knew the country, the impossibility of using such a route.

The name of the river appears to have been given by the fur-traders, from the number and extent of the gravel bars on its lower reaches. The Indian name for the main river is the Bacotyeh, signifying the 'meat drying river,' and the north branch they call the Twitya, or the 'river that flows from a lake.'

Indians.—A small band of Indians, numbering about 110, including men, women and children, inhabit the country in the vicinity of the Ross and Pelly rivers. These people trade their furs with Messrs. Lewis and Field, who established a small trading post at the mouth of the Ross river about 1900. Previous to this they traded at the distant Hudson's Bay Company's upper post on Liard river. These Indians have always been careful during their hunting expeditions not to approach too closely the headwaters of the Ross or Pelly rivers on account of evil spirits, in the shape of gigantic Indians, who were supposed to inhabit the mountains about the divide.

About 100 Indians hunt and trap on the Gravel river and its branches, trading fur and dried meat at the Hudson's Bay Company's post at Fort Norman. They are called the Mountain men in distinction to the Indians who hunt on the plains around Great Bear lake and trade at the same post, and are a superior class of men

1 Summary Report of the Geol. Survey of Canada, 1902.
2 J. Keele. The Uper Stewart River region, Yukon.
3 C. Camsell. Peel river and tributaries, Yukon and Mackenzie.
4 A. H. Murray. Journal dated Youcon, May 1, 1848. Bulletin of the Archives Branch, Ottawa.

to these or the Pelly Indians. The Mountain men and their families generally leave Fort Norman in September, walking over a direct trail to the Gravel River valley, up which they trap and hunt. Sometimes during the late winter they cross the divide, to the headwaters of the Stewart, Macmillan, and Ross rivers, where certain kinds of fur are more plentiful. In the spring they return to the Gravel river and build mooseskin boats, in which they descend that river to the Mackenzie. The Mountain Indians have hunted on the Gravel river for a long time; there are meat-drying racks everywhere along the stream banks. Some of their signs are very old, showing evidence of stone implements having been used.

It was probably a long time before they grew bold enough to cross the divide, but even now they are careful not to go far down the streams on the western slopes for fear of meeting the fierce Yukon Indians; so that mutual fear and distrust have established a dead line over which representatives of neither side pass.

The white trappers who came up the Yukon tributaries in the years following the Klondike rush, having no traditional fears, made large catches of marten and beaver in this avoided territory.

In 1898, Mr. Frank Braine brought a party of Indians from Fort Good Hope, across the Mackenzie mountains, and established them on the Stewart river at the mouth of Lansing river. He erected a trading post at this point, bringing up his supplies from Dawson every summer.

The Indians on the Peel and Wind rivers have gone over the summit to Dawson to trade of late years, instead of to Fort McPherson as formerly. So that gradually the evil repute of this great mountain divide is passing from the life of the Indians.

The Indians, unfortunately, are not thriving; disease yearly decimates their thin ranks, and even the picturesque and hardy Mountain men are succumbing under its dreadful influence.

TOPOGRAPHY.

General Description.

The highlands which lie between the Yukon and Mackenzie rivers are a portion of that great mountain system known as the North American Cordillera, which forms the western border region of the continent.

5419—p. 12 Diagram of Mountain Systems in Northwestern Canada.

Two of the well-known topographic types that exist in the better known southern portion of the Cordillera have their northern counterpart in this region.

The country of comparatively low relief bordering the Lewes and Yukon rivers, to which the name Yukon Plateau has been applied, corresponds in position and topography to the Interior Plateau region of British Columbia.

The higher and more rugged mountains to the east, which form the water-parting between the upper Liard and Yukon on one side, and the main Mackenzie river on the other side, represent the northwestern continuation of the Rocky mountains proper. The name Mackenzie mountains is given to this portion of the system.

The Mackenzie mountains appear to be well defined; their axis is crescentic, the southern point lying in the valley of the Liard river, and the northwestern extremity reaching the lowland between the Yukon and Porcupine rivers.

It is the greatest mountain group in Canada, and appears to consist of two ranges, an older western range, against the eastern edges of which a newer range has been piled.

The names Selwyn range and Ogilvie range have been applied in former reports and on previous maps, to cover a considerable portion of these mountains. It has been found impossible to define the limits of these subdivisions, on topographic grounds, hence the name Mackenzie mountains has been given to the highlands as a whole. The name Selwyn mountains has been restricted to the mountains lying between the forks of the Macmillan river and Hess river, but it remains for future investigators to assign the proper limits to the Ogilvie range.

A number of important rivers have their source in, and flow for considerable distances through the Mackenzie mountains. Draining the eastern slopes and falling into the Mackenzie are the Nahanni, Root, Gravel, Carcajou, Arctic Red river, and Peel river. On the western side and tributary to the Yukon are the Pelly, Stewart, Klondike, and Chandindu; while the southern and southwestern slopes are drained by branches of the Liard.

The western front of the Mackenzie mountains merges into the Yukon plateau at various localities, so that it is often difficult to define the border line between these two topographic provinces. Several detached mountain groups are so well separated from the main range that they have been treated on former occasions as

distinct features, and they are also described accordingly in the following pages.

On account of structural differences, the eastern portion of the Mackenzie mountains is more capable of subdivision as regards topographic features than is the western side.

There are two, or probably three parallel ranges which cross the Gravel river, trending in a northwest-southeast direction, with crests dominating the country on each side of them.

On Père Pettitot's map,[1] published in 1875, the mountains flanking the western side of the Mackenzie river are designated the Sa-yunne-kwe or Ti-konan-kkwene, signifying 'rocks of the big-horn' and 'backbone of the earth.' These names, with a slight variation in the spelling, have been adopted for two of the ranges.

The Sayunei range crosses the Gravel river at its junction with the Natla, and the Tigonankweine range crosses below the mouth of Twitya river.

Yukon Plateau.

Bordering the Lewes, Yukon, and lower portion of the Pelly rivers, is a broken upland country in which hills, valleys, ridges and mountains succeed one another in an irregular manner and without system. A spectator, standing on one of these hills at an elevation of 2,500 feet above the river, sees flat-topped or dome-shaped hills, connected by a multitude of long, level or gently-sloping ridges, the whole forming a fairly even sky-line. Overlooking the depressions in which the drainage channels lie, the observer could conceive the tops of the ridges and hills to indicate the remnants of a former plain, of a rolling or undulating character.

The assumption here is, that a plain of such a description once stood at a much lower elevation, but has since been uplifted. The effect of the uplift was to increase the erosive power of the streams over the area, and consequently to cut the plain to pieces, thus evolving the present type of topography.

In the vicinity of the Yukon and Pelly rivers the flat-topped summits of this region have a general elevation of about 2,500 feet above the rivers, or about 4,000 feet above sea-level.

The principal valleys within this area have gently-sloping walls, with a tract of fairly level lowland a few miles in width bordering

[1] Bulletin de la Société de Géographie, Paris, 1875.

the rivers. These strips of lowland along the main rivers constitute the only available land for agricultural purposes in the region.

The higher portions of the plateau are covered with grass or scrub, while dark-green coloured groves of spruce partly cover many of the bottom lands and extend a considerable distance up the slopes of the valleys. In many places level terraces follow along the sides of the hills, forming wide and easy steps, which are usually thinly wooded with poplar or small pine or covered by a rich grassy turf. In fact much of the Yukon plateau resembles the attractive foothill region east of the Rocky mountains, in the Province of Alberta.

Plateau Ranges.

The Pelly river flows through the plateau region, from the mouth of the Macmillan river to the Yukon, a distance of seventy-five miles. East of this point is a belt of broken and rugged country, but with mountains of Alpine character, whose higher peaks rise to a height of 7,000 feet or more above sea-level. These mountains, which roughly trend northwest, are groups rather than a continuous range, being often widely separated by extensive low-lying drainage channels, or by stretches of hilly country of low relief.

Several of these mountain groups are known by distinctive names—the Pelly and Glenlyon mountains border the Pelly river to the south, and the Macmillan, McArthur, and Kalzas mountains lie to the north of the Macmillan river.

The change from the plateau region to the more rugged type of mountains is generally by a gradual transition, but in some instances these rugged masses rise from the plateau as from a pedestal, hence the name plateau ranges is used here for purposes of description.

Spurs from the main ranges lying to the east approach close to these plateau ranges, so that it is often difficult to define the western border of the former, especially as the same type of mountain and a similar topography exist in both divisions.

The valleys that branch in all directions through the plateau ranges are generally basin-shaped, having broad alluvial flats bordering the rivers, and easy side slopes reaching to the summits.

It has been suggested by Dr. Dawson that these isolated mountains may represent the remnants of a former range, having an axis nearly parallel with the main range, and antedating it as a physical feature. But since several of these mountain masses are known to

have granite cores, which harden the sedimentary rocks in their vicinity, and the great thicknesses of argillites in the country rock elsewhere are easily weathered, their isolation may be due to prolonged differential erosion, acting on a generally uplifted and deformed region.

The Pelly and Glenlyon mountains, however, are more widely separated from the main range than any of the other groups, by a belt of plateau country—rather higher in elevation than the Yukon plateau—which extends southward from the Pelly river, embracing the upper Liard and the Frances rivers. There is not sufficient knowledge at present concerning these mountains, to state their relationship to the plateau or the main ridge with any degree of certainty.

Mackenzie Mountains.

The high, rugged mountains, farther up the streams, east of the flanking groups, and including the divide, present a fairly massive front, with no important lowland areas breaking their continuity.

The crest line of these mountains is uneven both in course and in profile, for included within them are groups of mountains of a more subdued type, and many wide, branching valleys, that are trenched well back to the main divide. The structure is characterized by folding, generally on a broad scale, which has thrown the strata into a series of anticlines and synclines; but the folding is sometimes close, and in certain cases the folds appear to be overturned and overthrust. Many structural details, however, are concealed by the easy, well-wooded valley slopes, but the outcrops for long distances on the rivers often show steeply-inclined beds of the same kind repeated at intervals.

The topographic features are governed to some extent by the geology, for although the main drainage ways, as adjusted at present, cut across hard and soft strata alike, many of the wide valleys are carved out of the soft strata, while the higher ridges and peaks are formed of the uptilted hard beds. The highest peaks and the ones displaying the most rugged crests are built of granite stocks or pillars, which from their hardness, and greater resistance to weathering, continue to stand above the surrounding sedimentary rocks.

The surface features in general, are those which result from long-continued differential erosion, acting on a generally uplifted and deformed region. Certain modifications have been introduced by

PLATE IV.

View of Mount Sheldon from Sheldon Lake.

PLATE V.

View of valley of the Ross River at Field Lake.

glacial action, such as the smoothing of inequalities in the bed-rock, and the flooring of the main valleys with drift, thus submerging the lower slopes of the mountains. The lakes and ponds of various size which so often occur in the valleys, owe their origin, in many cases, to glacial action.

The higher mountain peaks of this region often exceed 7,000 feet in height above sea-level, and a few isolated peaks probably measure 8,000 feet, while the summits of many of the groups associated with them do not exceed about 6,000 feet, the vertical relief being from 3,000 to 4,500 feet.

The summit of the Christie pass, between the heads of the Ross and Gravel rivers, stands at a considerable elevation, being about 4,525 feet above sea-level, but there are routes on the Macmillan and Stewart rivers, leading to the Mackenzie waters, which are said to traverse valleys lying well below timber line, containing small lakes and an ill-defined water parting at the divide.

The mountains in the vicinity of the watershed are not higher than many of the groups situated at considerable distances from it, so that the divide is not the most important element in the relief of the region, and does not form a natural division line separating the eastern and western slopes as distinct topographic provinces.

The development of valleys at the headwaters of streams is further advanced on the western side of the divide, this advantage being probably due to the greater amount of precipitation, and consequently the greater erosive power exercised on that side.

About forty miles east of the divide the topography changes in a marked degree, and a more compact and rugged mountain region is entered. The drainage channels of this region are confined in narrow valleys, with steep, barren slopes of rock and talus, the rivers in the bottom flowing in a very contracted bed, which at rare intervals opens out into a narrow alluvial flat.

The structure of these mountains differs from that of the ranges to the west, being apparently due to fracturing, buckling and faulting of the strata, and the residual masses present the appearance of a series of faulted and tilted blocks. The principal lines of fracture are in a northwest-southeast direction, and the beds have a prevailing southwesterly dip.

Escarpments produced by tilted strata, overlooking fault valleys, are the most prominent features, but they do not appear to persist in alignment for any great distance.

The highest peaks are roughly pyramid-shaped masses, carved from the harder of the stratified rocks of which the mountains are built. They vary in elevation from 6,500 to 7,500 feet, with a height above Gravel river of 3,500 to 6,000 feet. The denudation of these mountains has not reached such an advanced stage as that exhibited by those to the westward; the valleys are narrow and steep-sided, and the grade of the drainage channels is much steeper.

The Mackenzie mountains, as a whole, have a maximum width of about 300 miles; there is no well-defined crest line, but they appear to be rather a complex of irregular mountain masses, which are the result of deformation and uplift. The topography of the western portion bears evidence of long-continued differential erosion, while the eastern portion has the appearance of being in a more youthful topographic stage. Both in geology and structure the eastern portion of these mountains is closely related to the Rocky mountains in southern Canada.

Mackenzie Valley.

On the Gravel river the high mountains approach to within a distance of about fifty miles of the Mackenzie river, and are then replaced by a belt of foothills about 3,000 feet in height above sea-level. These foothills in turn decline in elevation and finally die out in a broken, wooded plain, about 600 feet above sea-level, bordering the Mackenzie river.

About twelve miles eastward of the Mackenzie rises a narrow range of mountains, parallel to the river. These are known as the Franklin range. They are a spur of the Rocky mountains which crosses the Mackenzie river at latitude 62° 30′, or near the mouth of the Nahanni river. They attain their greatest elevation opposite the mouth of the Gravel river, the principal peak being Mount Clarke, about 5,000 feet. According to Père Pettitot, this range can be traced almost to the shores of the Arctic ocean.

DRAINAGE.

A portion of the drainage of the western slope of the Mackenzie mountains falls into the Frances river, and thence by the Liard and Mackenzie rivers into Beaufort sea, but the greater part is taken by tributaries of the Yukon river to Bering sea. All the drainage of the eastern slope falls into the Mackenzie river.

PLATE VI.

Terrace of Glacial Clay, Ross River, above Sheldon Lake.

PLATE VII.

View of Itsi Mountains from Ross River.

There is a great disparity both in river development and stream grades between the two sides of the divide.

On the western slope the water flows from near the divide, for a long distance, through valleys of mature erosion with an easy grade before reaching the master stream, the Yukon; while the streams on the eastern slope fall rapidly for a comparatively short distance and reach a much lower level at their junction with the Mackenzie. For example, the Ross and Pelly rivers have a combined length of 450 miles, and enter the Yukon at an elevation of about 1,500 feet above sea-level, while the Gravel river, 255 miles long, enters the Mackenzie at a height of about 200 feet above sea-level.

Owing to the great difference in precipitation the streams from the west side of the divide carry down to the Yukon more than twice as much water as the streams over an equal area on the eastern side. Thus the Gravel river and its branches do the work on the eastern side of the divide, while the combined efforts of the Hess, Macmillan, and Ross rivers are required to carry the water from the western slope; the Gravel river being about equal in volume to the Macmillan.

The higher mountains of the western slopes are more or less covered with snow during the greater part of the year, and receive a moderately copious rainfall; so that they are the gathering ground of numerous streams. These flow into the forks of the Pelly, Macmillan, and Ross rivers, which have a general southwest direction before joining the main stream. The greater part of the main drainage ways, therefore, lies transverse to the strike of the rocks, and to the trend of the mountains. The main Pelly river, however, flows in a general northwesterly direction, along the strike of the rocks, and in a valley flanked by parallel mountain ranges.

The time of flooding generally occurs early in June: when the rushing waters of the streams become powerful erosive and scouring agents, effectively removing the surface deposits of various kinds which floor the valleys, sometimes to great depths. These deposits, which consist of glacial drift and silts, form the banks of the streams, but an occasional spur of rock outcrops on the river.

In flood-time the water reaches far up the banks, sapping and undermining them, and the rivers, with the greatly increased current due to their swollen condition, quickly carry away the material that falls in, so that the rivers are constantly widening the trench in

which they flow. There is a certain amount of constructive work done, as bars and new islands may be built up or banks made higher, but the whole process is a continual shifting of material from one point to another down stream.

As the rivers shrink in volume, long beds or bars, composed of the coarser pebbles derived from the banks, are exposed along the water's edge, and the water unable to attack the friable banks becomes clear; then the rivers cease to be active agents of erosion until next flood-time.

During the winter the rivers shrink considerably in volume, being fed altogether from underground water. In some of the small branches, water from a local source is liable to overflow the ice at intervals, and promptly freezing after each overflow builds up a considerable thickness of ice, which may extend down-stream for miles. The remains of these icefields, often 10 feet in thickness, may be seen in July.

In spring, the small side streams are the first to open, then the pressure from the increase of water in the main streams arches the ice-sheet, and finally breaks it up. The broken ice usually jams at some point lower down, the pent-up water behind the jam breaks out again, and sweeps the river clear of ice. This operation is repeated until the entire river is open, no ice being left at the margins.

After the ice goes out there is generally low water in the rivers until the summer floods come.

The small lakes which occur at intervals on the Ross river are features not possessed by any of the other rivers, for although lakes of various sizes are of common occurrence in the valleys of the region, they are not situated directly on the main drainage system, but drain into them by brooks.

The lakes on the Ross river are shallow basins, a few miles in extent, and not more than 45 feet in depth. They are gradually being filled by sedimentation, and their level lowered by cutting down at the outlets; so that if present conditions continue undisturbed they will in time be obliterated.

The Gravel river on the eastern side of the divide is a vigorous stream, still in its youth, but sufficiently developed to have eroded its bed for the greater part of its course to a fairly even grade. It gathers a considerable volume of water in its early stages, and flows in a general northeast direction to join the Mackenzie.

From its source at the divide, to the point at which it leaves the mountains, the river scours bed-rock in a continuous rapid, or flows over boulders which are too large to be carried.

The Gravel river receives three large tributaries—having a slightly higher grade than the principal stream—which probably head at the main divide.

The principal streams are independent of rock structure, and except in a few minor deviations flow across the strike of the rocks; but most of the smaller streams, conforming to the trend of the rocks, enter the main streams at right angles, thus producing a rectangular system of drainage.

The side streams are all steep and carry down a great deal of debris to the main stream, which, owing to its high grade and volume is able to handle all the material delivered to it.

As the river leaves the high mountains it drops some of its load, due to a slight decrease in velocity, and not having time to sink a bed in this material, the river flows across it, and splits up into several smaller channels. On entering the plain bordering the Mackenzie there is a further deposition of load, and as the river now has room to spread out, it forms a network of channels, about a mile wide, all flowing swiftly around gravel bars. These bars are nearly all composed of coarse gravel and small boulders, the fine material being all swept down stream, the amount of the latter material carried by the stream exceeding the amount of coarse material deposited.

There is very little decrease in velocity as the Mackenzie river is approached, and the Gravel river finally rushes into the greater river, with an impact that carries its water and sediment several hundred feet into the latter before it is brushed aside by the flood of the great river.

The Gravel river has built up an alluvial flat at its mouth, and several alluvial islands in the Mackenzie below this point are probably due to the great load of sediment carried in at flood-time.

A rough measurement of the Gravel river above its mouth, taken on July 19, gave a width of 700 feet, a middle depth of 8 feet, and a surface velocity of five miles an hour; the approximate discharge being 25,000 cubic feet per second. It is probable that the river shrinks greatly in volume by the end of August, as the snow is then almost completely gone from the mountains, and the rainfall is very light.

There are no lakes in any part of the valley of the main Gravel river, and none were seen from any of the mountains overlooking its tributaries.

CLIMATE.

The region lying between the Yukon and Mackenzie rivers possesses, as a whole, an extremely variable climate within the year, while the topographic provinces included within this area exhibit certain climatic differences; the peculiarities being chiefly as regards precipitation.

The Yukon plateau, protected from the prevailing westerly winds by mountain ranges from 5,000 to 10,000 feet in height, has an arid climate, very little wind, and temperature ranging from 80° in June to −60° in January.

The western slopes of the Mackenzie mountains, of higher elevation and exposed to the prevailing winds, have a comparatively high precipitation, and periods of high winds, while the eastern slopes being on the lee side receive a small precipitation, and immunity from the high winds. The average monthly temperature, however, does not vary much over the three provinces.

June is a perfect summer month with practically no darkness, and on fair days nearly twenty hours of bright sunshine; the temperature sometimes reaches as high as 90°.

January is the coldest month of the year, with about five hours' sunshine on unclouded days; the temperature seldom rises above zero, and for several days is down to 60°, or lower.

Three months of the year, from May 25 until August 25, are practically free from frost in the valley bottoms.

July, August, and September are the months of greatest rainfall, which is scanty over the Yukon plateau, being only about 7·5 inches in the year. There are no recorded measurements in the mountains to the eastward, but it is probably not less than thirty inches annually.

The greatest amount of snow falls during the late autumn and early winter. In March, 1908, the snow was five feet deep in the valley of the Ross river near the divide, but on the Pelly river it would not be more than half that depth at the same time.

On the east side of the divide the snowfall is light, being three feet less than on the west side in 1908.

PLATE VIII.

Wilson Peak from Christie Pass.

PLATE IX.

5419 – p. 22. Glaciated Mountains near source of Gravel River.

On and after September 1, fresh snow begins to appear on the mountains, while rain is falling in the valleys. The first few falls of snow generally disappear from the valleys, but remain on the mountains, consequently there is a much greater accumulation of snow there.

The small watercourses begin to freeze about the middle of September; the ice begins to form on the larger streams early in October, and they are generally closed by the end of that month.

The water becomes very low in winter, the streams being fed altogether from underground sources, and very little erosion of any kind goes on then, as no rock fragments or debris of any kind were seen on the snow slopes on the mountains.

In the lengthening days of May the snow begins to disappear in the valleys, principally by insolation and evaporation, and by the first of June very little remains except on the mountains.

The rivers open between May 10 and 20, and flood-water comes down early in June, after which a period of high water continues until about the middle of July, or later if the season is a rainy one.

Owing to the thawing of the frozen ground, there is considerable moisture in the mountains above tree line, even after the snow is gone. This water collects in pools or runs down the slopes in rills, carrying a certain amount of rock waste to lower levels.

When mountains become low enough to permit a growth to cover their summits the protection thus afforded by tree, shrub and moss keeps the frozen ground beneath from thawing, so that those mountains are practically at a standstill as regards sub-areal denudation, and can only be attacked by headwater stream erosion.

The effect of insolation in east and west lying valleys is well marked in the difference presented by the aspect of the valley slopes. Those facing the south are generally of easy and uniform grade, with large, open, thinly-wooded tracts, or bare ground; while those facing northward have steeper declivities, which are closely wooded or moss covered.

On account of the long period of sunshine during the days, nearly all the snow disappears from the Mackenzie mountains before the summer ends.

Vegetation advances very rapidly in summer, and where the soil is good, vegetables of many kinds may be grown along the river banks in the principal valleys.

Small fruits, such as raspberries, blueberries, red and black currants, and two varieties of cranberry are abundant and of good quality.

The change from an arid climate to one of greater humidity is apparent by the growth, to any one ascending the Pelly river. The lower part of this river is very attractive in appearance, the valley being bordered by open, grassy terraces, and the immediate banks of the river bearing groves of tall white spruce. This aspect disappears on the Ross river, where a ragged growth of white and black spruce covers the banks and the valley bottom, and the slopes are covered with a thick carpet of moss, under a light growth of black spruce, interspersed with willow and alder swamps.

In passing over the divide an arid region is again reached on the lee side of the mountains, where growth is sparse and the soil is of poor quality.

Tree growth extends to within a short distance of the summit of Christie pass on the western side, but on the eastern side trees are not seen until a descent of about 900 feet is made.

FAUNA.

The Yukon territory contains some of the best sections of game country in Canada, and many trappers and prospectors have been able to live for long periods almost entirely on the proceeds of the rifle and net.

Of late years, however, game of all kinds has become very scarce in some localities, owing to the extensive killing carried on by those who hunt for the market offered by mining camps.

The Indians having lately acquired high-power magazine guns, are responsible for a great deal of slaughter, as the average Indian who gets into a band of big game shoots as long as his cartridges hold out, whether he can use the meat or not. Head hunters who come into the country in search of fine specimens, do a great deal of damage, as they have been known after a day's hunting, to leave enough meat to spoil on a hillside to supply a prospector with provisions for a whole winter. These men at the end of their hunt will take out about twelve heads each, which would mean the killing of twenty animals.

The moose is the chief game animal, and is still plentiful in the valleys of that part of the Pelly river and its tributaries which flow through the Mackenzie mountains.

Almost any fine day in summer, from the top of a mountain, a few moose can be located in the valleys below, by the aid of a pair of field glasses.

The valley of the Ross river affords a good range for moose, as it is sprinkled with numerous small lakes, and several extensive willow patches, which furnish the most desirable food and environment.

There are a few moose scattered along the valley of the Gravel river, but it is not a good moose country, as there are no small lakes, and on account of the narrow valleys, and low timber line, the area over which they can feed is restricted.

Cariboo are found in small bands on some of the mountain groups on the Pelly and Macmillan rivers. They select mountains of a subdued type, having large expanses of table land, and as long as their favourite moss is plentiful do not leave that neighbourhood unless forced to.

It is true that cariboo collect in large numbers in the northern part of the Mackenzie mountains, and moving herds were frequently seen on the headwaters of the Klondike river, but there is no such herding or movement on the part of the small bands on the Pelly branches.

Cariboo were observed only at one locality on the Gravel river, near the edge of the first timber, about twenty miles from the divide.

The mountain sheep are in small scattered bands, and inhabit only a few selected mountain groups. They require a feeding ground above timber line, from which the wind blows the snow in the winter time, and convenient crags to afford a place of retreat from enemies. During the summer the sheep venture down to the valleys, in search of alkaline clay, which they desire to lick at certain periods; but for the most part they keep above timber line.

The sheep on the Stewart river are all pure white, while those on the Macmillan and Pelly rivers range in colour from white to almost black.

Sheep are plentiful on parts of the Gravel river, particularly on the low mountains between the Sayunei and the Tigonankweine ranges. Among the hundreds of sheep seen by the writer in this locality none but those with pure white wool were observed.

The sheep are highly prized for their heads, and on account of their flesh, which is the best of all the wild meat, consequently they are hunted to extermination in any of the accessible localities.

Black, brown, and grizzly bears are more or less numerous, but are not often met with, except in the month of August, when they come out along the banks of the Yukon tributaries to feed on the salmon.

Black and grey timber wolves are scattered throughout the region, but they are very rarely seen during the summer months. In winter they assemble in packs, and make regular hunting trips up and down the valleys, killing large numbers of moose.

The salmon come up the Pelly river and its tributaries about the latter end of July, reach the spawning grounds in August and are all dead by the end of that month.

Thousands of salmon in all stages of decay were lying along the bars and on the bottom of the Ross river, when we descended that stream in August.

Whitefish, inconnu, and pike are found in greater or less abundance, in all the streams and lakes in the region. A net set in any favourable place rarely fails to take some of the above varieties.

Grayling were plentiful on the Pelly river, and numbers were easily taken with a rod and line, using an artificial fly for bait.

Grayling, herring, and a variety of brook trout were the only fish found in the Gravel river, there being an abundance of grayling; but herring and trout were rarely taken.

Great numbers of wild geese breed along the main rivers tributary to the Yukon, the nesting sites and feeding ground being among the willows and on the mud bars close to the streams. Scattered pairs of swans frequent the small lakes in the wide valleys during the summer, but they gather in large flocks in the late autumn before taking their departure to the south. The geese and swans do not frequent the Gravel river, as the conditions there are unsuitable.

Fur Trade.

Furs are the principal articles of value at present derived from the Pelly river and its tributaries.

During the year 1898, and the few following years, numbers of white men ascended these rivers in the search for gold, but never succeeded in finding it in paying quantities.

Some of these men, attracted by the great extent of country in which fur-bearing animals were found to be numerous, settled temporarily in the country to make a living by trapping.

The few that still keep up the search for gold are forced to spend considerable of their time in trapping and hunting as a means of subsistence.

The following estimate by Mr. R. B. Riddell, who trapped for several years on the Macmillan river, gives an approximate idea of the value of the furs taken on the Pelly and Macmillan rivers:—

Year.	No. of Trappers.	Kind of fur.	Value.
1901	15	Principally marten	$ 7,000
1902	40	" "	15,000
1903	50	" "	20,000
1904	50	Marten and lynx	18,000
1905	30	Principally lynx	8,000

There were also a small number of beaver, wolverine, and fox taken each year, and included in the above estimate.

The Indians take nearly an equal amount of fur, making a total for the Pelly trade during the above five years of $136,000.

In 1904, lynx invaded the Pelly region, coming from the south, and disappeared during 1907, moving northward.

The marten disappeared soon after the arrival of the lynx; they returned in 1907 to the parts of the region not frequented by lynx, but in this year both marten and lynx are reported as being very scarce.

The movements of the lynx were probably governed by their food supply, because in the years previous to 1904, rabbits were extremely abundant in the Pelly country, and the lynx appear to have followed the rabbits. In the following years the number of rabbits steadily declined, and in 1907 they had practically disappeared.

While the movements of small carniverous animals are governed by food supply, their disappearance from a certain locality can often be accounted for by the fact that they are trapped almost to extermination.

The Indians seldom trap a locality out, as they are forced to move their camps often in search of game, and consequently trap lightly over a large area.

The white man brings in most of his provisions, establishes himself in some chosen locality, builds a headquarters cabin, and a number of small outlying shelters, and devotes all his time to trapping, using steel traps as well as dead-falls. Consequently in a few years the fur in his neighbourhood diminishes to such a degree that he is forced to select new grounds or seek some other employment.

FORESTS.

A monotonous growth of coniferous forest of varying density covers the bottoms of the valleys in the Pelly basin, and reaches far up the sides of the mountains.

The limit of tree growth averages about 4,500 feet above sea-level; it varies according to the aspect and nature of the slope.

The forest consists of white and black spruce, aspen and balsam poplar, black pine, balsam fir, and birch; and a few small larch were observed on the Pelly a few miles above Woodside river.

The principal tree is the white spruce, which grows at its best on the alluvial banks and islands on the lower part of the main rivers, where it attains a diameter averaging about 12 miles. Timber of this size is confined to a narrow strip on each side of the rivers; in the valley beyond this strip, the trees are smaller and of poorer quality, having an average diameter of about 7 inches.

A small quantity of timber is cut every year along the Pelly and Macmillan rivers, and taken down to Dawson in rafts, where it is sawn into lumber, but the supply of commercial timber is limited, there being only sufficient for local use.

The black pine grows only on a limited area, being confined to terraces along the lower part of the rivers; the trees do not exceed about 9 inches in diameter.

The balsam fir is found on the mountain slopes all the way up to tree line, but does not grow in the bottoms of the principal valleys.

Toward the headwaters of the streams the timber becomes smaller and more scattered. Except for a few stunted balsam at the southern entrance, the Christie pass is quite devoid of tree growth.

The valleys at the headwaters of the Gravel river are entirely bare of trees, the first timber met with after leaving the Ross river being fifteen miles beyond the watershed, and consisting of a meagre growth of black spruce confined to the river bank.

The balsam fir and black pine are absent on the Mackenzie slopes, but the larch extends up the valley of the Gravel river for about 150 miles.

The timber resources of the Gravel river are very moderate, the white and black spruce trees of any importance being confined to the alluvial flats, which on this river are very limited in extent, and the best white spruce groves average about 10 inches in diameter.

The height to which timber will grow on the mountain slopes varies very considerably in the Gravel River valley, but the average height is about 4,000 feet above sea-level. Generally very few trees grow higher than about 1,000 feet above the river, owing to the steep slopes of rock and talus of the valley walls.

The valley of the Mackenzie river in the neighbourhood of the Gravel river is sparsely wooded with an inferior tree growth.

TRANSPORTATION.

Small steamers of light draught and sufficient power can ascend the Pelly river, during high-water stages, as far as the mouth of the Ross river, a distance of 250 miles from the Yukon, or up the Macmillan river as far as the forks. At least one steamer comes up to Ross river every summer, carrying trappers and prospectors with their freight; also bringing supplies for a fur-trading post at this point. The charge on freight from Dawson is $50 a ton, and for each passenger $50; the journey can be made in six days, but usually takes longer.

The traveller who wishes to go further, either tracks his own boat up stream or walks across country.

Pack-horses could be used over a limited portion of the country, particularly along the open benches of the main valleys, but the wet mossy floor, the thick growth, and the scarcity of feed in the upper valleys would be found serious obstacles to their use.

Dogs are frequently used as pack animals by the trappers and Indians during the summer; a good dog will pack forty or fifty pounds. In winter most of the travelling is done on the rivers, with dogs hauling the necessary outfits on sleds or toboggans. If the loads to be hauled are heavy, the trail must be broken a day ahead to allow it to freeze hard enough to hold up the dogs.

It is quite possible to boat up the Pelly river, but with heavy loads it is a hard task, as the current is strong and steady and there

are numerous stiff riffles. Two portages must be made, either going up or down stream: one at Hoole cañon of half a mile, and another at Wolf cañon of one and three-quarter miles, these cañons being, respectively, 23 and 143 miles above Ross river. Two rough bed-rock rapids occur: Hoole rapid, just below the river of that name, and Slate rapid, about sixteen miles above Campbell creek. A boat with small load can be lined up both these rapids, on the west bank, and they can be run with safety by competent boatmen coming down stream.

Beyond Wolf cañon the Pelly is navigable for small boats for a distance of at least forty miles.

About six miles of swift broken water is encountered on the Ross river, after leaving the Pelly. Above this there are about seventy-five miles of river with a moderate current, and several shallow riffles. Above this there is a stretch of twenty miles of swift water, in which occur four short rapids, past which goods have to be portaged, but the empty boat can be hauled up with the line.

Sheldon lake is the limit of boat navigation in low water, but in high stages of water, John lake, or even Wilson lake, might be reached, with light loads, and much labour. Wilson lake is about thirty miles from the divide, over a winter trail. Suitable water for boating on the Gravel river is reached at a distance of about thirty miles beyond the divide, and from this point to the Mackenzie the current never moderates, the river being swift throughout its course. The Gravel river is best descended at high water stages, when the larger boulders are covered and the rougher rapids drowned out. The Indians use mooseskin boats about 30 feet long, 6 feet wide and 4 feet deep, made of eight or ten mooseskins stretched over a stout green spruce frame.

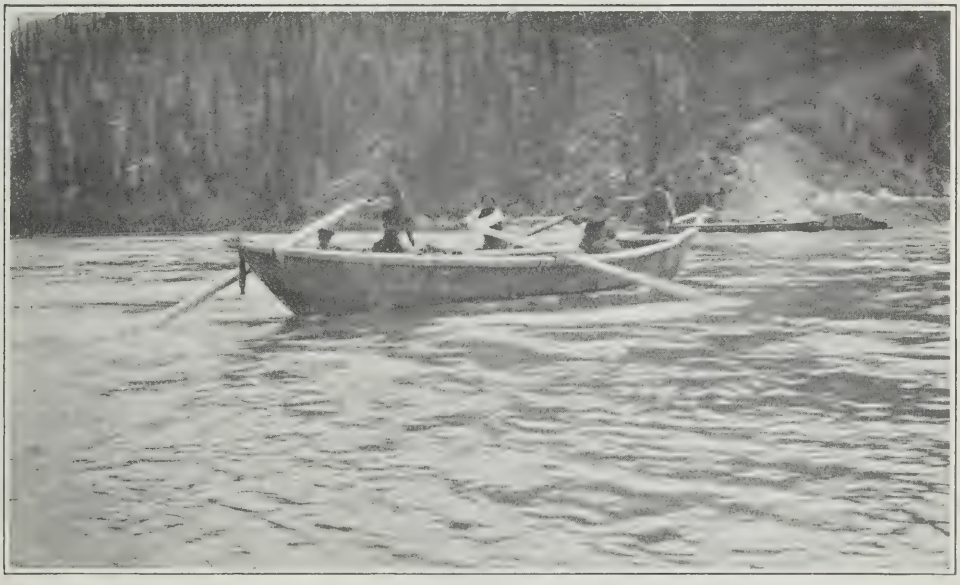
It is practically impossible to take a loaded boat up the Gravel river.

The Hudson's Bay Company have recently placed a new steamer on the Mackenzie and Slave River route, which has accommodation for several passengers, as well as a good freight capacity. This steamer makes two trips each summer down the Mackenzie, on the first trip going to Fort McPherson on the Peel river, but on the second journey not farther than Fort Norman. On the first trip up stream this steamer connects with a regular line of transport to Edmonton.

PLATE X.

Post-glacial Cañon on brook near Spring Camp, Gravel River.

PLATE XI



5419—p. 30. Indians in mooseskin boat, descending Gravel River.

GEOLOGY.

General Description.

The rocks which were found in the vicinity of the Pelly, Ross, and Gravel rivers may be divided into three main groups: (1) Stratified rocks, (2) Intrusive rocks, (3) Metamorphic rocks, the first group being by far the most widely distributed.

The term stratified rocks is used to include shales, slates, sandstones, conglomerates, limestones, dolomites and cherts, and beds of lava and tuff. Beds of these rocks occur interstratified with one another, and with few exceptions have been disturbed by various causes from the attitude in which they were originally laid down, the deformity of the beds being often extreme.

The intrusive rocks are mostly coarsely granular, being of a granitic character, and occur only in small bodies widely separated from each other.

The metamorphic rocks which result from the alteration of either of the others, have a wide distribution in some parts of the Yukon territory, but are limited to a small area on the Pelly river. They consist chiefly of schists and gneisses; the metamorphism is very pronounced, the original characteristics of the rocks being obscured by the development of new minerals and different structure. The term metamorphic rocks is used for this series, because it is descriptive of these rocks as a whole; in the sedimentary group there are also metamorphosed rocks, but the alteration in those is not usually so marked, and it seldom obliterates all clue to their origin.

The group of sedimentary rocks of which the Mackenzie mountains are built shows a generally different lithologic character on either side of the divide. The western portions of the mountains are composed of rocks which appear to have been laid down mostly as shallow water deposits, with frequent changes in the kind of material deposited, and under unstable conditions due to intermittent volcanic action. The processes of mountain building, and the intrusion of various bodies of igneous rocks have partly changed the original character of many of the beds in these sediments.

The sedimentary rocks on the eastern side of the divide are, for the most part, the result of sedimentation and precipitation carried on farther from shore lines and under conditions which were unchanging over long periods. The mountain building has not altered

these sediments to any extent, and with one exception they were, wherever observed, entirely free from association with igneous rocks of any kind.

The main line of traverse followed from the Pelly to the Mackenzie was in a northeasterly direction, or across the trend of the rock formations, so that all the principal members of the rock groups were observed at some points. But there are large areas where no rock exposures were seen, this being the case in the lower part of the Ross river and during the winter journey across the watershed. The observations on the Ross river are supplemented by observations on the Macmillan and Stewart rivers made in former years, over similar rocks; observations on the eastern slopes are confined to the Gravel river alone.

Fossils collected at a few localities were sufficiently preserved to give a definite position in the stratigraphic column to the beds in which they were found. A brief account of the fossil fauna, and their relationship to the stratigraphy, as far as known, is given in the subdivision on stratified rocks.

Owing to incompleteness of data, in a region of folding and faulting, the writer is unable to give the proper sequence and thickness of the strata, and for this reason no local names are given to any subdivision because they cannot be defined at present as stratigraphic units.

Rock Formations and Distribution.

The crystalline schists which occur on the Pelly river at many points from the Yukon up to Ketza river, are the most important rocks in the region, as placer gold is generally found associated with them. Above Ketza river they are exposed at only a few places, and are not seen at all beyond Campbell creek.

Their extension south of the Pelly is not known, but as they are found on Hoole river it is probable that they extend to the base of the Pelly mountains, and then trend in a southeasterly direction along the upper Liard and Frances rivers.

The crystalline schists are found along the Ross river for a distance of about twenty miles above its mouth. They consist in this locality of greenish and dark grey quartz mica schists, and actinolite or talcose schists, derived from both sedimentary and volcanic rocks.

The greater part of the schists are highly altered sediments, but associated with them are some basic igneous rocks which have been

intruded along the bedding planes of the older formation and subsequently sheared and altered.

The various rock members which make up this formation have been subjected to such a high degree of metamorphism that their boundaries and original structure have been destroyed, and a schistosity common to them all has been developed.

The strike or trend of the rocks is generally northwestward, and they dip at various angles, the strata being broadly folded as a rule.

Quartz veins and stringers are numerous in places, but on the Pelly quartz does not constitute as large a portion of the rock mass as it does in similar rocks at other localities.

The crystalline schists have a wide distribution in the Yukon territory, and have been described in a few localities under the name Nasina series; the rocks in the area under consideration probably represent the same series.

Nothing is known of the age of these rocks, except that they are older than adjoining and overlying sedimentary rocks in which fossils of Ordovician age have been found, but they may be pre-Cambrian.

The contact between the crystalline schists and the Palæozoic rock has not been observed at any point where traverses were made from one to another.

The crystalline schists on the Pelly river are replaced in the vicinity of Ketza river by thinly-bedded black and grey cherty quartzites, associated and interbedded with white marble.

Above the mouth of Campbell creek several masses of greenstone occur which are intrusive in the quartzites, and the marble is replaced by massive beds of yellowish weathering crystalline dolomite.

At Slate rapids, and for some miles above, grey argillites both of shaly and slaty varieties, with some limestone beds, form the banks of the Pelly river, the slates at the rapids being overlain conformably by several thick beds of chert breccia, which are made up principally of small fragments. The mountains above the mouth of Woodside river are made up of very compact laminated quartzite interbedded with schistose slates. The beds seen along the river assume all possible attitudes, and no fossils were found; so that from the brief examination given to them, it is impossible to state what the sequence is. Some slabs of black argillite containing graptolites were found among the gravel on a bar near Slate rapids, which

would indicate that a middle Ordovician horizon exists somewhere in this vicinity.

On going up the Ross river, the black shaly argillites of False cañon, seventeen miles from the Pelly, succeed the crystalline schists, which were last seen a few miles below this point. Beyond False cañon the few exposures seen for the next fifty miles consisted of thinly-bedded quartzites and argillites, similar to those on the Pelly river, or of small detached masses of diorite, and andesite.

A fairly continuous section, of about fifteen miles in length, seen along the river below Lewes lake, shows a remarkably complex series of closely folded rocks, with rapid alternation in bedding and composition. These consist of red, green and grey slates, or argillites, chert, quartzite, limestone, sandstone, grits, and volcanic tuffs.

No organic remains of any description were found in this group, but they are placed provisionally as Silurian, for reasons which are given further on.

The argillaceous rocks of the group are varied in colour, and in the degree of alteration, and exhibit a slaty cleavage at right angles to the bedding, or a shaly structure, where the beds are made up either of thinly laminated layers or of wedge-shaped fragments.

The most important limestone band in the series varies in thickness from 10 to 150 or 200 feet in thickness, in beds of 2 to 12 inches thick, and dark grey in colour.

The sandstones are made up chiefly of quartz fragments; they are very hard, and do not weather easily. A thin section under the microscope shows that the material has been crushed and strained prior to the consolidation of the rock, so that it is evidently derived from the erosion of the underlying crystalline schists.

The grits are made up of quartz grains about the size of corn, without much cementing material, and occur in rather massive beds which are well displayed in the walls of Prévost cañon. There are varying degrees of coarseness in these quartzose clastics, and they often occur interbedded with grey shales.

The strong red colour of some of the slates, and the rather remarkable quartz grits, have served to identify this group of rocks at the following widely separated localities: The Pelly river, in the vicinity of Wolf cañon; the Macmillan river, near Russell creek; and the Stewart river at Tasin mountains.

On the Ross river this group of rocks is succeeded and apparently underlain by dark grey argillites or black slates, cherts and

quartzites; and the exposures from Lewes lake to the divide show a monotonous succession of these types.

A bed of black indurated shale from one of these exposures about seven miles below John lake contained graptolites of upper Ordovician age.

There is a great quantity of argillites and cherts with some dark coloured limestone on the upper part of the Macmillan river, which McConnell[1] places above the red slates and associated rocks, but they are similar in every respect to the Ross River rocks, above Lewes lake.

The beds of chert breccias which form a considerable thickness at the upper part of the section on the Macmillan river were not seen at all on the Ross river, otherwise the sections on the two rivers are very similar.

There is a wide band of thinly-bedded black chert south of the red slate beds on both streams. Whether these cherts are part of the main area of similar beds which occur on the upper part of the streams or not, is doubtful.

On the Ross river the red slate and associated beds appear to lie in a basin formed by the cherts and argillites. On the Macmillan river the attitude of the rocks apparently indicates a descending series on going up stream, until the red slate beds are reached, but McConnell remarks that the regularity of the dip is probably due in a large measure to overturn folds and faults.

The mountains of the watershed at the head of the Ross river are formed of alternating beds of dark compact quartzite and grey shale and slate.

About ten miles east of the divide some yellowish crystalline limestones occur in low isolated cliffs along the embryo Gravel river, but the principal rocks are dark sandy shales, striped grey slates and micaceous sandstone or quartzose schists. Rocks of this character extend eastward to Mount Sekwi, about fifty miles from the divide, and then end abruptly.

The relationship of the rocks on the upper part of the Ross and Gravel rivers—including the divide—to the great body of cherts and argillites lower down the Ross river was not determined, and no fossils were found, but the striped grey slates included in them resemble those associated with the red slates and quartz grits.

1 Summary Report, Geological Survey, 1902, p. 31.

A radically different geological province begins at Mount Sekwi, and limestones, dolomites, sandstones, and conglomerates, etc., of various bright colours, replace the sombre rocks to the westward.

The distribution of these rocks is at present known only in a very limited way, but it is probable that formations similar to those subsequently noted here, will be found to have a wide northwest-southeast extent on the eastern slopes of the Mackenzie mountains, from the Liard to the Arctic Red river.

The structure, the character and sequence of the strata, and the organic remains, all indicate that the eastern part of the Mackenzie mountains is geologically as well as physically the northern counterpart of the Rocky mountains, and that at least two series of rocks, the Bow River and the Castle Mountain groups of southern British Columbia and Alberta, are represented here.

Stratified Rocks.

PALÆOZOIC STRATA.

Cambrian.

Purple and greenish argillites, in beds from a few inches to over a foot in thickness, are exposed at the base of the mountain, at the junction of the Natla with the Gravel river. Above the argillites are dolomites, calcareous sandstone and limestone; these beds have a total thickness of about 4,000 feet, and incline at a low angle to the southeast. The dolomites form a considerable portion of the section, the lower beds are white and crystalline, while those near the top are a striped grey colour. All have a soft yellow coating on the exposed surfaces. The limestone occurs in thin slabs containing fossils, is rather impure, and weathers to a bright yellow colour.

A small collection of brachiopods found in these beds was submitted to Dr. Ami, who referred them to *Billingsella* of Hall and Clarke, a form usually characteristic of the Cambrian system. Not having foreign material to compare them with, he sent them to Dr. Schuchert, of Yale University, who recognized the species to be '*Billingsella Coloradœnsis,*' Shumard, usually referred to the middle Cambrian, but which has also been recorded in the upper Cambrian. The form *Eo-orthis desmopleura*, Meek, sp., was also identified in the same specimens.

Below the mouth of the Natla river the mountains are composed of rocks quite different from the foregoing, which dip up stream

and appear to pass under them. This strata is made up in descending order of—

Brown micaceous sandy slates	1,100 feet.
Conglomerate	2,000 "
Coarsely laminated hematite and siliceous slate	100 "
Dolomite and argillite	1,000 "
	4,200 "

No fossils were found in any of these rocks, and they were only seen along this portion of the river, being cut off by a fault at their northern end. The conglomerates form the wall rock of Shezal cañon.

These rocks from their position probably constitute the middle or lower portion of the Cambrian,[1] and probably correspond to the Bow River series described by McConnell,[2] while the rocks found above the mouth of Natla river are referable to the Castle Mountain group.

Ordovician.

That part of the Tigonankweine range through which the Gravel river flows is built up of rocks which are here included in the Ordovician.

Below the mouth of Twitya, on the north side of the Gravel river, the rocks lie nearly horizontal, the base of the section showing about 4,000 feet of alternating beds of argillite, dolomite, and limestone; above these are about 1,500 feet of sandstone. Just below the sandstone is a sill of diabase about 100 feet thick and several miles in extent.

Fossils were found in a thick bed of limestone on a mountain a few miles north of the mouth of Nidhe brook. Mr. L. M. Lambe reports the following forms from a small collection of fossil corals brought down from this point:—

Favosites aspera?, d'Orbigny.
Calapœcia canadensis, Billings.
Halysites catenularia, var. *gracilis*, Hall.
Columnaria rugosa, Billings.

Also a cephalopod, referred by Dr. Ami to

Actinoceras Bigsbyi, Stokes,

1 It is possible that they may be pre-Cambrian.
2 R. G. McConnell. Ann. Rep. Geol. and Nat. Hist. Survey of Canada, 1886, Vol. II., part D.

a form eminently characteristic of the Black River formation in eastern Canada.

The great development of sandstones in this section is remarkable. They get thicker going eastward, and opposite the mouth of Nainlin brook, they form, with only an occasional shaly parting, the entire mountain mass, or about 4,500 feet of horizontal strata.

The prevailing colour of the sandstone is reddish, but in several places it is grey, with rusty specks. The beds vary in thickness from a thin, flaggy variety up to 3 feet. The red sandstones are mostly indurated, some of the beds being changed to quartzite.

About seven miles below John lake, on the Ross river, a small collection of graptolites was obtained from some black indurated shale interbedded with cherty argillites, and cherts. Dr. Ami reports the following forms, and refers the beds containing them to the upper part of the Ordovician system:—

Orthograptus quadrimucronatus, Hall.
Leptograptus flaccidus, Hall.
Orthograptus or *Glossograptus*, sp.

Silurian.

The eastern part of Mount Sekwi, on the Gravel river, is composed of dove coloured limestones in beds, varying from a few inches to a foot or more in thickness, thrown into a vertical attitude.

The limestone beds pass into grey argillites, having slaty and schistose phases, and are interbedded with sandstone or quartzite.

The bulk of the limestones appeared to be unfossiliferous, but a small loose piece found on the mountain side contained some fossil shells, which proved to be a *Camarotœchia*, closely related to *C. acinus*, Hall; also part of a corallite of a *Cyathophyllum*.

Some distance east of Mount Sekwi the above beds assume a nearly level position, but gradually rise again until they are tilted toward the west at a high angle.

The section here shows over 2,000 feet of rather pure limestones, the bottom beds being of a compact dark grey variety; the beds at the top are light coloured, porous, and semi-crystalline, and some shaly and silicified beds occur at intervals.

A partly silicified bed of limestone near the top of the section showed a profusion of badly preserved organic forms, principally large branching corals.

PLATE XII.

View looking up valley of the Gravel River from Mt. Sewki.

PLATE XIII.

Sekwi Canon, carved in Silurian limestone.

Of the few of these brought out, Lambe reports the following forms:—

Favosites, sp.
Streptelasma, sp.
Acervularia gracilis, Billings.

Also two specimens of a Stromatoperoid, *Actinodictyon Keelei*,[1] described as a new species by Dr. Parks, and a Pentamerus, which was kindly examined by Dr. Charles Schuchert, of Yale University, New Haven, who pronounces it to be apparently an undescribed species, and nearest to *Papillosus*.

Devonian.

The sandstones classed as upper Ordovician extend down the Gravel river nearly to Inlin brook, and are then replaced by limestones, more or less massive, but the contact with them was not seen. The limestone beds are broken into several faulted blocks, dipping to the southwest, with low escarpments facing the northeast, and here constitute the eastern foothills of the Mackenzie mountains.

No fossils were found in the limestones of the foothills, but they are probably lower Devonian. As the foothills decrease in altitude going eastward, the limestones become less tilted and broken, the bedding is thinner and several shaly layers appear. Brachiopods are abundant in some of these beds, particularly *Atrypa reticularis* (L.) and *Atrypa spinosa*, Hall, and the following corals which were determined by Lambe:—

Streptelasma rectum, Hall.
Phillipsastræa verneuili, Milne-Edwards and Haime.
Hederella canadensis, Nicholson.

MESOZOIC STRATA.

Fossils of Triassic age were found by the writer in some impure limestones, in the upper Stewart River region in 1905, and a large area of rocks was coloured as Triassic on a map of that region published a few years ago. Since then there has been reason to believe that these rocks are Palæozoic, and that only a small remnant of Triassic rocks was enfolded with them.

A similar case occurs on the Pelly river below the Ross river, where a small undefined area of rocks was found by Dawson to

[1] W. A. Parks. 'Silurian Stromatoperoids.'

contain plants of upper Cretaceous age, but the different character of these rocks to the surrounding crystalline schists renders them conspicuous in this locality.

A few exposures of soft sandstone and conglomerate were found lying unconformably on the chert beds on the Ross river above Sheldon lake. No satisfactory examination of these could be made at the time, on account of the snow, but they are probably of Mesozoic age.

About twenty-five miles from the Mackenzie some soft sandstones and conglomerates are exposed for a few miles, along the north bank of the Gravel river; the beds are inclined slightly toward the west, and have a thickness of about 200 feet.

The sandstones are coarse grained and nodular, of yellowish or grey colour, grading into fine conglomerates, which are made up chiefly of black cherty argillite fragments.

No fossils were found in these rocks, and although no exposures were seen below this point, they are probably part of the same series found on the Mackenzie river, in this neighbourhood, which McConnell refers to the upper Cretaceous.

The Cretaceous beds occupy the depression between the base of the Mackenzie and the Franklin ranges, and have a width of about twenty miles in the vicinity of the Gravel river. They overlie Devonian limestones and shales.

TERTIARY STRATA.

The Tertiary rocks which occupy a basin of limited extent on the Mackenzie river at the mouth of Bear river, are described in detail by McConnell[1] in his report.

Basalt occurs in low bluffs, for a distance of about fifteen miles along the Pelly river near Hoole river. It is pre-glacial, and Dawson has classed it provisionally as miocene from analogy with similar deposits in British Columbia. Nothing further was learned of its age or origin by the writer.

IGNEOUS ROCKS.

The unaltered igneous rocks appear in this region only as small isolated masses among the sedimentary or metamorphic rocks.

Granite was seen about ten miles up the Ross river, where it forms a ridge about 1,800 feet high on the north side of the river.

[1] R. G. McConnell. Ann. Rep. Geol. and Nat. Hist. Survey of Canada, Vol. IV., 1888-89, Part D, pp. 95-100.

The rock is a fine-grained, brownish coloured, biotite granite, and is intrusive in the crystalline schists which are seen exposed around the base of the ridge.

This granite is different to the bodies which sometimes form the centre of the mountains in the sedimentary rocks, being finer grained and of a more acid type. It has been exposed to erosive influences for a long period, and the profile of the ridge is similar to adjacent ones composed wholly of sedimentary rocks.

Several important bodies of igneous rocks occur as stocks, or cores, in the higher mountains, or mountain groups. Mount Sheldon, overlooking the lake of that name on the Ross river, is so formed.

The rock here is a granite porphyry, of exceedingly coarse grain, in the form of a pillar, which has eaten its way up through the Palæozoic sediments.

The contact is well defined; the granite has merely baked, and rendered brittle the argillites enclosing it.

The granite is well jointed, and weathers into a serrated crest, the argillites being worn away for a distance of several hundred feet below the summit.

As the granite stocks or pillars become unroofed they offer greater resistance to weathering than the mountains composed entirely of sedimentary rocks, hence the mountains possessing granite centres persist longer at high elevations, and are also more conspicuous by reason of their bolder outlines and more rugged crests.

Itsi mountain and Mount Wilson are of this character, and several mountains on the Macmillan and Stewart rivers, which are prominent topographic features, were found to be built of granite.

On the banks of the Ross river between Big Timber creek and the first rapid, are a few isolated exposures of granodiorite and rhyolite, both bedded and massive, but the relation of these bodies to the sedimentary rocks and to each other was not seen.

On Pelly river below Slate rapid are a few outcrops of diabase, intrusive in slates and quartzites. This rock is fine grained and much altered, is traversed by veinlets of quartz and calcite, and becomes slightly schistose at the margins.

Large boulders and blocks of similar rock were seen on the lower part of the Ross river, but were not found in place in that locality.

Igneous rocks appear to be almost absent on the Gravel river, the

only occurrence observed being a sill of diabase intruded between beds of horizontal sandstone.

The diabase was first seen below the mouth of Twitya river, where it forms a cliff 100 feet high, about 3,000 feet above the river, on the mountain on both sides of the valley. Some miles farther on a fault brings the diabase down to the level of the river. It is coarse grained, and much decomposed, with a roughly columnar structure.

Superficial Deposits.

The valley floors of the Pelly river and its tributaries are all covered with drift deposits of varying thickness. Most of this material appears to have been laid down by the complex action incident on the occupation of the region by glaciers.

A complete section of the drift shows rolled gravels at the bottom, then boulder clay, above which are sands and gravels, usually stratified, with silt on top. The deposits are very irregular, and their sequence varies in every section examined, it being frequently found that two layers of boulder clay are separated by stratified sand and gravel.

The drift is usually thickest along the lower portion of the streams, where sections are generally seen rising to a height of 300 feet above the river, while older terraces of similar material rise to a height of 900 feet.

Although there are some detached thick heaps of drift material in the upper valleys, the drift sheet is usually thin, and boulder clay is either altogether absent or else confined to patches of small extent.

Deposits of drift are found on the Ross river throughout the greater part of its course. The immediate banks are usually low, averaging about 15 feet, and only rising in a few places to 40 or 50 feet, but remains of older terraces of drift 100 feet or more in height occupy the base of the valley slopes. The boulder clay member of the drift on the Ross river is dark in colour, not very coherent, and contains mostly fine pebbles, differing in many respects from that of the Pelly, which is yellow in colour, generally stiff and carries chiefly large pebbles. The gravel, clay and silt on the Ross river is stratified in fairly regular beds, and does not exhibit the confused arrangement so common on the Pelly and Macmillan rivers.

The wash gravel in the river bed is principally composed of small fragments of chert or argillite derived from the prevailing country rock, which crumbles down very fine, but in contrast to this fine

material large angular or partly rounded blocks of granite and fine-grained greenish diabase are strewn at intervals over the bed of the river, or are perched on the banks.

A large deposit of unsorted drift material which contains a good percentage of rounded granite pebbles occurs on the river below Lewes lake, and terraces of the same material rise to a height of 300 feet above the present level of the lakes. The wide valley containing Prévost river intersects that of the Ross at this locality, and it is probable that during the shrinkage of the ice an overloaded glacial stream from both valleys discharged at this point, building up sufficient material to act as a dam and pond the water for some distance above.

Another extensive deposit of glacial material occupies the valley bottom about ten miles above Sheldon lake, of which bluish earthy clay, abounding in pebbles, is the chief component. In this the Ross river has sunk its channel to a depth of 450 feet, leaving two series of very perfect terraces which border the valley for several miles.

In the upper part of the valley of the Ross, the principal deposits of drift are in the form of esker ridges extending from the base of the slopes, the material composing these ridges being sand and gravel or boulders, with very little clay.

About the middle of Christie pass there are some mounds about 200 feet high composed of angular quartzite and fragments of slate from the surrounding mountains, also several rounded and sub-angular granite pebbles, but very little sand or fine material. Three of the mounds occupy isolated positions in the middle of the pass, while others are attached as benches to the northern side. They have a gently-rounded outline with flattened summits, and appear to be remnants of a large area of drift.

The Gravel river after leaving the divide flows in a shallow trench sunk in the rocky floor of a poorly developed valley.

No superficial deposits of any importance were observed above the mouth of Tsichu brook; below this point are a few sections of roughly stratified gravels about 100 feet in thickness.

This deposit is not of any great horizontal extent, as a bed-rock bench 200 feet higher than the gravel bench rises a short distance beyond the latter. A few patches of typical yellowish boulder clay, but showing peculiar lines of bedding, are found in this vicinity. Granite boulders of large size are very numerous; these litter the beds of the side streams, and are scattered over the valley slopes.

An important terrace of gravel about 200 feet high occupies the triangular space of a few miles in extent at the junction of the Natla with the Gravel river.

The terrace is composed of river gravels, with boulders and pebbles of sandstone, dolomite, limestone, and slate, but only a few small granite pebbles are present, and below this point granite is altogether absent from the river wash.

Where the banks of the stream are not of solid rock, they are generally composed of the above material, but mostly in low banks from 10 to 20 feet in height.

At several points, the river banks are the truncated alluvial cones brought down by the side streams, and these generally contain a large proportion of angular or only partly rounded fragments of rock.

Sections of a thin sheet of boulder clay are seen at intervals. This material is generally stratified, and contains a layer of gravel and sand without admixture of clay.

Above the mouth of Nainlin brook, the river bank is composed of about 120 feet of dark blue clay, quite structureless, and containing a few pebbles, the larger of which have flattened and scratched surfaces. Most of the pebbles are small and well rounded, the greater part being of granite and gneiss of various character.

Granite pebbles are absent from the gravels for a distance of seventy miles above this point, and they were evidently carried up the valley of the Gravel river by glaciation from the east, the pebbles being typical of the rocks of the great Laurentian area.

On the opposite shore below this point are banks of the usual Gravel River boulder clay about 80 feet high, showing bands of gravel and silt. The boulder clays from the two sources show marked differences in colour, composition and structure.

Below this point the granite pebbles in the wash increase in size and number, but are not found up the side streams above a level of about 200 feet higher than the main river.

The thickest deposit of drift on the river occurs about eight miles below the mouth of Inlin brook, where the river turns eastward through the foothills.

The base of this section shows typical boulder clay, above which are bedded silts, and above the silts is another deposit of boulder clay; on top is a bed of earthy non-coherent clay containing only a

PLATE XIV.

Mountains of the Sayunei range, Natla River.

PLATE XV.

Mount Delthore, and Shezal Canon, Gravel River.

few pebbles. All these materials are of a dark-grey muddy colour, and have a total thickness of about 500 feet.

The broken plain bordering the Mackenzie is underlain by blue clay with a more or less gravelly admixture, on top of which is yellowish sand or sandy gravel. The gravels contain a large proportion of black chert or slate pebbles derived from the underlying Cretaceous conglomerate.

About four miles from the Mackenzie the Gravel river swings against a clay bank about 200 feet in height, and of a dark-grey colour. The lower part of this clay is stratified, and appears to be quite devoid of pebbles, but the upper 50 feet or so contain scattered pebbles.

The river is undermining this bank, and at intervals large masses of clay, becoming detached from the face, fall with a roaring noise into the swift water.

Glaciation.

It would appear that during the glacial epoch a thick deposit of ice accumulated among the mountains, the gathering ground being on the western slopes.

This ice sheet, judging from the height at which foreign material was found on the mountains, was about 3,000 feet in thickness, and although it did not cover the highest peaks was thick enough to override the lower mountains and ridges, so that the glacier was a confluent one over the region and also the northern extension of the great Cordilleran glacier.

The movement of the ice during its maximum development was controlled to a great extent by the main drainage valleys, and flowed down those almost, but not quite, to the Yukon river.

When the ice became thick enough on the western slopes of the Mackenzie mountains it began to pour through the gaps and passes of the divide and to send streams down the valleys of the Gravel river and its branches.

The ice divide appears to have been situated at one period of the glaciation to the west of the present watershed, because granite drift was carried from the western side part of the way down the eastern slopes, but it is probable that on the shrinkage of the glacier the ice divide shifted to the present watershed, as the accumulation of drift in Christie pass appears to have been deposited at a zone of stagnation, or where there was no movement of the ice.

The depth which the ice of the Cordilleran glacier attained in the valley of the Gravel river was not satisfactorily determined, the effects of glaciation not being so pronounced as on the Pelly and its tributaries. It is probable, however, that there was a depth of at least 2,000 feet on the lower part of the river.

The valley of the Mackenzie river was occupied by an ice sheet of considerable thickness, which pushed up the valley of the Gravel river, before the ice from the Cordilleran glacier began to pour down.

A large boulder of gneiss was seen at the mouth of Nidhe brook, at a height of 1,800 feet above the Mackenzie river, showing that the two ice sheets merged somewhere in that vicinity. The drift pushed up by the Mackenzie glacier is mostly all cut away by the present stream for a long distance below that point, and the first large accumulation occurs above the mouth of Nainlin brook, thirty miles below the mouth of Twitya river.

According to McConnell's[1] observations, the ice from the gathering ground on the Archæan area to the east, poured westward through the gaps and passes in the Franklin range, and, flooding the Mackenzie valley, was deflected northward by the great barrier formed by the Mackenzie mountains, in a stream approximating 1,500 feet in depth.

Camsell[2] noted water-worn pebbles and boulders of gneiss on the summit of Mount Goodenough, a mountain built of Cretaceous strata, about 3,000 feet high, overlooking the delta of the Mackenzie.

According to these later observations then, ice from two gathering grounds, an eastern and a western one, combined in the Mackenzie valley, and the maximum thickness of this ice must have been considerably over 3,000 feet.

It is probable that local glaciers remained in some of the higher mountain groups after the general disappearance of ice from the field. The only permanent ice of any account now remaining in the region is confined to a few small patches about a square mile in extent, in the cirques of the Itsi mountains, which lie between the Ross and Macmillan rivers.

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1 R. G. McConnell. Ann. Rep. Geol. and Nat. Hist. Survey of Canada, Vol. IV., 1888-89, Part D, p. 27.

2 C. Camsell. Peel river and tributaries, Geol. Surv. of Canada, 1906. p. 40.

Valley of Gravel River and Tigonankweine Range, above mouth of Twitya River.

VVII.

Cliffs of Ordovician Sandstone, overlying a sill of diabase, slopes of Mount Eduni, Gravel River.
5419—p. 46

ECONOMIC GEOLOGY.

Prospecting for gold began on the Pelly river as early as 1882. For some years subsequently, a few miners working on the gravel bars made as much as $10 to $20 a day each, their operations being confined to the lower portion of the river. Since then prospecting has been carried on along the greater part of the river and many of its tributaries; but no mining of importance has yet been done in the region.

Fine and coarse colours of gold are found in the gravels over a large area, but no coarse gold in paying quantities has yet been located on bed-rock.

There appears to be a close connexion in the Yukon territory between the crystalline schists and the lacer deposits. In the valley of the Pelly, these rocks appear to occupy a belt extending for a distance of about ten miles on each side of the river, which flows generally parallel to their strike. In the vicinity of Campbell creek, however, the Pelly river turns northeastward, while the belt of crystalline schists continues in a southeasterly direction along the Frances and upper Liard rivers.

In 1875, some prospectors from the Cassiar gold-fields, in search of new grounds, reached the headwaters of Frances river, and worked on some bars, obtaining gold which paid at the rate of $8 to $9 a day, and there is no doubt that the Yukon gold-fields would have been entered and discovered at that time from this quarter, if the route were an easier one, and not so remote from any base of supplies.

For the last few years work in the Pelly district has been confined to the streams entering the Pelly from the south, from and including Lapie river to Hoole river.

These streams head in the Pelly mountains, a high range, lying south of and parallel to the course of the Pelly. Along the base of these mountains lies a wide abandoned river valley, floored with wash gravels and containing several small lakes. This old valley is separated from the Pelly river by a narrow belt of low rocky hills, through which the streams have cut channels. The gravels of the old valley carry coarse and fine colours of gold, and the streams in flowing across it concentrate a portion of this gold on bed-rock.

The best prospects so far have been found on some of the small tributaries of Hoole river.

The Duncan mining district, to the north of the Pelly, resembles the country in the vicinity of the latter in many respects. Coarse gold in paying quantities was found in that region about ten years ago, and almost every year since then discoveries of more or less importance have been made. In spite of the large area over which gold has been found in the Duncan country, there are serious difficulties hard to overcome, which prevent it from becoming a successful mining camp. These are: underground water, large boulders, and lack of adequate transportation to ensure a supply of provisions for miners.

Fine gold is found in the gravels all along the Pelly, from the Yukon to Campbell creek, but none is found above this point.

Mr. Henderson tested a few bars above Hoole cañon, using two sluice-boxes, about 12 feet long, and collected several pounds of the heavy dark sand which accompanied the gold. A greyish-white, malleable mineral in small scales, which was presumed to be platinum, is abundant in this sand.

The samples were submitted to Mr. R. A. A. Johnston, mineralogist to the Geological Survey, who states it to be ferro-nickel, a rare mineral, but of no commercial value in such small quantities. The bulk of the black sand is composed of magnetite and garnet.

The bars that produce best on the upper Pelly, begin about a mile below Hoole cañon and extend up stream for about sixteen miles.

The surface gravels to about a foot in depth yield approximately 2½ cents to the pan, and 1½ cents at two feet below the surface. The boulders are not large and the gravels are not frozen.

A few years ago three men rocked on the bars above Hoole cañon, and made about $2.50 per day each. The gold is very fine and hard to save, but Mr. Henderson says that with better appliances for washing the gravel, and saving the gold, it is possible to make from $5 to $6 per day.

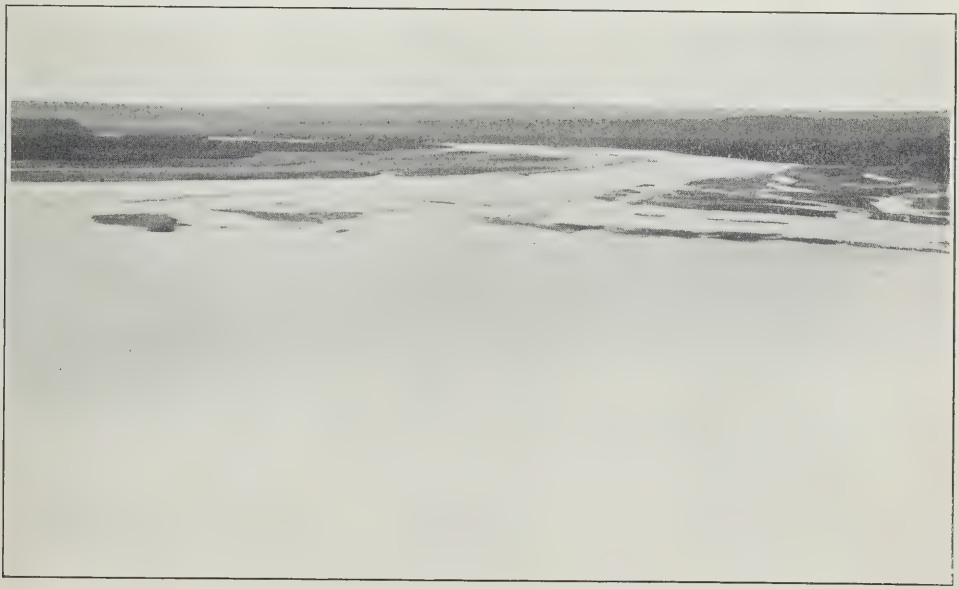
Veins and stringers of quartz, which are probably due to the after-effects of igneous intrusions, are abundant in the crystalline schists. The occurrence of gold was not traced directly to the quartz seams in this locality, but the gold in deposits of economic importance has been limited to those areas in which the rocks are highly altered, and disturbed by frequent intrusions.

During the glacial period part of the ice which filled the Pelly valley came from the southeast, and moving over a large area of

PLATE XVIII.

Gravel River, flowing through foothills in Mackenzie Valley.

PLATE XIX.



Junction of Gravel River with the Mackenzie.

schists and slates, transported some of the pre-glacial accumulation of gold from these rocks. It is probable that the gold in the bars of the main river is derived from the glacial drift. The river does a certain amount of cutting into these deposits at every flood stage; the gold scattered through the drift is fine enough to be carried in the turbid water. The concentrations of gold are generally restricted to small areas at the head of each bar, and on account of their shallowness and small extent, diggings of this nature are soon exhausted.

The mineralization of the schists by the igneous intrusions was not confined to the deposition of gold, as in other localities various minerals of more or less importance are found associated with coarse gold on bed-rock. These minerals are cassiterite (oxide of tin), scheelite (calcium tungstate), bismuth, stibnite (antimony sulphide), zinc blende, arsenical pyrites and iron pyrites.

Although these minerals have not been reported from the Pelly region, it is possible that they occur there, and on account of their heaviness are likely to be found concentrated in sluice-boxes.

Under present conditions, however, it is unlikely that anything but gold, which is by far the most valuable mineral known to occur there, will be sought for.

From the superficial examination given to the country in the vicinity of the Ross and Gravel rivers, it appears to be a most unattractive one to the prospector or miner.

There is a marked absence of vein quartz either in the bed-rock or stream gravels along the route. The intrusion of the granites in the sedimentary rocks does not appear to have been accompanied by any mineralization. The excess of silica usually accompanying granite intrusions appears to have permeated the argillites in an amorphous form, altering them to cherts. The silicification of the bedded rocks is on a large scale, as there are several thousand feet of chert beds extending over a large area.

An assay was made of a specimen from the bed of quartz conglomerate which crosses the Ross river at Prévost cañon, but no trace of gold was found.

At least two parties of miners have prospected in late years on the Ross river, but without success. Chas. Wilson, who has prospected on the upper portion of the river for the last three years, informed me that he only got colours of gold in one small

stream flowing into the Macmillan river, and that he found no coarse gold at all.

The explanation of Wilson's persistence in remaining in an apparently barren field is that he is in search of the legendary McHenry mine, a phenomenally rich deposit of placer gold supposed to exist in this vicinity. McHenry is said to have been a miner from the Dease Lake diggings, who penetrated to this region on a prospecting trip many years ago, and took out forty pounds in weight of coarse gold and nuggets. Various reasons were given for not returning again to his Eldorado, but he gave certain approximate directions by which it might be located, and many prospectors have been beguiled into the quest. A great deal of the country between the Macmillan and the headwaters of the Nahanni has been traversed in search of this lost mine.

Quantities of drift lignite are found along the lower part of Campbell creek, but the seams from which it was derived were not found. There is probably a small Cretaceous area lying on the schists in this neighbourhood similar to the one at Five Fingers on the Yukon river.

Drift lignite is also found on the lower part of the Gravel river, which is no doubt derived from the Tertiary coal-bearing areas of the Mackenzie basin.

Hematite occurs on the Gravel river about ten miles below the mouth of Natla river. This iron ore is coarsely laminated with red siliceous slate, having a thickness of from 50 to 100 feet, and is interbedded between conglomerate and dolomite. An assay of an average sample of this ore was made at the assay office of the Mines Branch, and gave only 25 per cent of iron.

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CANADA

DEPARTMENT OF MINES

GEOLOGICAL SURVEY BRANCH.

Hon. W. Templeman, Minister; A. P. Low, Deputy Minister;
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272	" "	1887.	698	" "	1898.
300	" "	1888.	718	" "	1899.
301	" "	1889.	744	" "	1900.
334	" "	1890.	800	" "	1901.
335	" "	1891.	835	" "	1902.
360	" "	1892.	893	" "	1903.
572	" "	1893-4.	928	" "	1904.
602	" "	1895.	971	" "	1905.
625	" "	1896.			

Mineral Production of Canada:—

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415	" 1887.	555	" 1894.	719a	" 1901.
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417	" 1889.	612	" 1896.	861	" 1903.
418	" 1890.	623	" 1886-96.	896	" 1904.
419	" 1891.	640	" 1897.	924	" 1905.
420	" 1886-91.	671	" 1898.	981	" 1906.
421	" 1892.	686	" 1899.		

Mineral Resources Bulletins:—

No. *818. Platinum.	No. 860. Zinc.	No. 881. Phosphate.
851. Coal.	869. Mica.	882. Copper.
*854. Asbestos.	872. Molybdenum and Tungsten.	913. Mineral Pigments.
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859. Salt.		

Reports of the Section of Chemistry and Mineralogy:—

No. *102.	Year 1874-5.	No. 169.	Year 1882-3-4.	No. 580.	Year 1894.
*110	" 1875-6.	222	" 1885.	616	" 1895.
*119	" 1876-7.	246	" 1886.	651	" 1896.
126	" 1877-8.	273	" 1887-8.	695	" 1898.
138	" 1878-9.	299	" 1888-9.	724	" 1899.
148	" 1879-80.	333	" 1890-1.	821	" 1900.
156	" 1880-1-2.	359	" 1892-3.	*958	" 1906.

* Publications marked thus are out of print.

REPORTS.

GENERAL.

745. Altitudes of Canada, by J. White. 1899.
*972. Descriptive Catalogue of Minerals and Rocks, by R. A. A. Johnston and G. A. Young.

YUKON.

*260. Yukon district, by G. M. Dawson. 1887. Maps Nos. 274, scale 60 m. = 1 in.; 275–277, scale 8 m. = 1 in.
295. Yukon and Mackenzie basins, by R. G. McConnell. 1889. Map No. 304, scale 48 m. = 1 in.
687. Klondike gold fields (preliminary), by R. G. McConnell. 1900. Map No. 688, scale 2 m. = 1 in.
884. Klondike gold fields, by R. G. McConnell. 1901. Map No. 772, scale 2 m. = 1 in.
*909. Windy Arm, Tagish lake, by R. G. McConnell. 1906. Map No. 916, scale 2 m. = 1 in.
943. Upper Stewart river, by J. Keele. Map No. 938, scale 8 m. = 1 in. } Bound together.
951. Peel and Wind rivers, by Chas. Camsell. Map No. 942, scale 8 m. = 1 in. } Bound together.
979. Klondike gravels, by R. G. McConnell. Map No. 1011, scale 40 ch. = 1 in.
982. Conrad and Whitehorse mining districts, by D. D. Cairnes. 1901. Map No. 990, scale 2 m. = 1 in.
1016. Klondike Creek and Hill gravels, by R. G. McConnell. (French). Map No. 1011, scale 40 ch. = 1 in.
1050. Whitehorse Copper Belt, by R. G. McConnell. Maps Nos. 1,026, 1,041, 1,044-1,049.

BRITISH COLUMBIA.

212. The Rocky mountains (between latitudes 49° and 51° 30°), by G. M. Dawson. 1885. Map No. 223, scale 6 m. = 1 in. Map No. 224, scale 1½ m. = 1 in.
*235. Vancouver island, by G. M. Dawson. 1886. Map No. 247, scale 8 m. = 1 in.
236. The Rocky mountains, geological structure, by R. G. McConnell. 1886. Map No. 248, scale 2 m. = 1 in.
263. Cariboo mining district, by A. Bowman. 1887. Maps Nos. 278-281.
*271. Mineral wealth, by G. M. Dawson.
*294. West Kootenay district, by G. M. Dawson. 1888-9. Map No. 303, scale 8 m. = 1 in.
*573. Kamloops district, by G. M. Dawson. 1894. Maps Nos. 556-7, scale 4 m. = 1 in.
574. Finlay and Omineca rivers, by R. G. McConnell. 1894. Map No. 567, scale 8 m. = 1 in.
743. Atlin Lake mining division, by J. C. Gwillim. 1899. Map No. 742, scale 4 m. = 1 in.
939. Rossland district, by R. W. Brock. Map No. 941, scale 1,600 ft. = 1 in.
940. Graham island, by R. W. Ells. 1905. Map No. 921, scale 4 m. = 1 in., and Map No. 922, scale 1 m. = 1 in.
986. Similkameen district, by Chas. Camsell. Map No. 987, scale 400 ch. = 1 in.
988. Telkwa river and vicinity, by W. W. Leach. Map No. 989, scale 2 m. = 1 in.
996. Nanaimo and New Westminster districts, by O. E. LeRoy. 1907. Map No. 997, scale 4 m. = 1 in.
1035. Coal-fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia, by D. B. Dowling.

ALBERTA.

*237. Central portion, by J. B. Tyrrell. 1886. Maps Nos. 249 and 250, scale 8 m. = 1 in.
324. Peace and Athabaska Rivers district, by R. G. McConnell. 1890-1. Map No. 336, scale 48 m. = 1 in.

703. Yellowhead Pass route, by J. McEvoy. 1898. Map No. 676, scale 8 m. = 1 in.
949. Cascade coal-fields, by D. B. Dowling. Maps (8 sheets) Nos. 929-936, scale 1 m. = 1 in.
968. Moose Mountain district, by D. D. Cairnes. Maps No. 963, scale 2 m. = 1 in.; No. 966, scale 1 m. = 1 in.
1035. Coal-fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia, by D. B. Dowling. Map No. 1,010, scale 35 m. = 1 in.

SASKATCHEWAN.

213. Cypress hills and Wood mountain, by R. G. McConnell. 1885. Maps Nos. 225 and 226, scale 8 m. = 1 in.
601. Country between Athabaska lake and Churchill river, by J. B. Tyrrell and D. B. Dowling. 1895. Map No. 957, scale 25 m. = 1 in.
868. Souris River coal-field, by D. B. Dowling. 1902.
1035. Coal-fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia, by D. B. Dowling. Map No. 1,010, scale 35 m. = 1 in.

MANITOBA.

264. Duck and Riding mountains, by J. B. Tyrrell. 1887-8. Map No. 282, scale 8 m. = 1 in.
296. Glacial Lake Agassiz, by W. Upham. 1889. Maps Nos. 314, 315, 316.
325. Northwestern portion, by J. B. Tyrrell. 1890-1. Maps Nos. 339 and 350, scale 8 m. = 1 in.
704. Lake Winnipeg (west shore), by D. B. Dowling. 1898. Map No. 664, scale 8 m. = 1 in. } Bound together.
705. Lake Winnipeg (east shore), by J. B. Tyrrell. 1898. Map No. 664, scale 8 m = 1 in. } Bound together.
1035. Coal-fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia, by D. B. Dowling. Map No. 1010, scale 35 m = 1 in.

NORTH WEST TERRITORIES.

217. Hudson bay and strait, by R. Bell. 1885. Map No. 229, scale 4 m. = 1 in.
238. Hudson bay, south of, by A. P. Low. 1886.
239. Attawapiskat and Albany rivers, by R. Bell. 1886.
244. Northern portion of the Dominion, by G. M. Dawson. 1886. Map No. 255, scale 200 m. = 1 in.
267. James bay and country east of Hudson bay, by A. P. Low.
578. Red lake and part of Berens river, by D. B. Dowling. 1894. Map No. 576, scale 8 m. = 1 in.
*584. Labrador peninsula, by A. P. Low. 1895. Maps Nos. 585-588, scale 25 m. = 1 in.
618. Dubawnt, Kazan, and Ferguson rivers, by J. B. Tyrrell. 1896. Map No. 603, scale 25 m. = 1 in.
657. Northern portion of the Labrador peninsula, by A. P. Low.
680. South Shore Hudson strait and Ungava bay, by A. P. Low. Map No. 699, scale 25 m. = 1 in. } Bound together.
713. North Shore Hudson strait and Ungava bay, by R. Bell. Map No. 699, scale 25 m. = 1 in. } Bound together.
725. Great Bear lake to Great Slave lake, by J. M. Bell. 1900.
778. East Coast Hudson bay, by A. P. Low. 1900. Maps Nos. 779, 780, 781, scale 8 m. = 1 in.
786-787. Grass River region, by J. B. Tyrrell and D. B. Dowling. 1900.
815. Ekwan river and Sutton lakes, by D. B. Dowling. 1901. Map No. 751, scale 50 m. = 1 in.
819. Nastapoka islands, Hudson bay, by A. P. Low. 1900.
905. The Cruise of the *Neptune*, by A. P. Low. 1905.

ONTARIO.

215. Lake of the Woods region, by A. C. Lawson. 1885. Map No. 227, scale 2 m. = 1 in.
*265. Rainy Lake region, by A. C. Lawson. 1887. Map No. 283, scale 4 m. = 1 in.
266. Lake Superior, mines and mining, by E. D. Ingall. 1888. Maps Nos. 285, scale 4 m. = 1 in.; No. 286, scale 20 ch. = 1 in.

326. Sudbury mining district, by R. Bell. 1890-1. Map No. 343, scale 4 m. =1 in.
327. Hunter island, by W. H. C. Smith. 1890-1. Map No. 342, scale 4 m. =1 in.
332. Natural Gas and Petroleum, by H. P. H. Brumell. 1890-1. Maps Nos. 344-349.
357. Victoria, Peterborough, and Hastings counties, by F. D. Adams. 1892-3.
627. On the French River sheet, by R. Bell. 1896. Map No. 570, scale 4 m. =1 in.
678. Seine river and Lake Shebandowan map-sheets, by W. McInnes. 1897. Maps Nos. 589 and 560, scale 4 m. =1 in.
723. Iron deposits along the Kingston and Pembroke railway, by E. D. Ingall. 1900. Map No. 626, scale 2 m. =1 in.; and plans of 13 mines.
739. Carleton, Russell, and Prescott counties, by R. W. Ells. 1899. (*See* No. 739, Quebec.)
741. Ottawa and vicinity, by R. W. Ells. 1900.
790. Perth sheet, by R. W. Ells. 1900. Map No. 789, scale 4 m. =1 in.
961. Sudbury Nickel and Copper deposits, by A. E. Barlow (Reprint). Maps Nos. 775, 820, scale 1 m. =1 in.; 824, 825, 864, scale 400 ft. =1 in.
962. Nipissing and Timiskaming map-sheets, by A. E. Barlow. (Reprint). Maps Nos. 599, 606, scale 4 m. =1 in.; No. 944, scale 1 m. = 1 in.
965. Sudbury Nickel and Copper deposits, by A. E. Barlow. (French).
970. Report on Niagara Falls, by J. W. Spencer. Maps Nos. 926, 967.
977. Report on Pembroke sheet, by R. W. Ells. Map No. 660, scale 4 m. =1 in.
992. Report on Northwestern Ontario, traversed by National Transcontinental railway, between Lake Nipigon and Sturgeon lake, by W. H. Collins. Map No. 993, scale 4 m. =1 in.
998. Report on Pembroke sheet, by R. W. Ells. (French). Map No. 660, scale 4 m. =1 in.
1075. Gowganda Mining Division, by W. H. Collins. Map No. 1,076, scale 1 m. =1 in.

QUEBEC.

216. Mistassini expedition, by A. P. Low. 1884-5. Map No. 228, scale 8 m. =1 in.
240. Compton, Stanstead, Beauce, Richmond, and Wolfe counties, by R. W. Ells. 1886. Map No. 251 (Sherbrooke sheet), scale 4 m. =1 in.
268. Megantic, Beauce, Dorchester, Levis, Bellechasse, and Montmagny counties, by R. W. Ells. 1887-8. Map No. 287, scale 40 ch. =1 in.
297. Mineral resources, by R. W. Ells. 1889.
328. Portneuf, Quebec, and Montmagny counties, by A. P. Low. 1890-1.
579. Eastern Townships, Montreal sheet, by R. W. Ells and F. D. Adams. 1894. Map No. 571, scale 4 m. =1 in.
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670. Auriferous deposits, southeastern portion, by R. Chalmers. 1895. Map No. 667, scale 8 m. =1 in.
707. Eastern Townships, Three Rivers sheet, by R. W. Ells. 1898.
739. Argenteuil, Ottawa, and Pontiac counties, by R. W. Ells. 1899. (*See* No. 739, Ontario).
788. Nottaway basin, by R. Bell. 1900. *Map No. 702, scale 10 m. =1 in.
863. Wells on Island of Montreal, by F. D. Adams. 1901. Maps Nos. 874, 875, 876.
923. Chibougamau region, by A. P. Low. 1905.
962. Timiskaming map-sheet, by A. E. Barlow. (Reprint). Maps Nos. 599, 606, scale 4 m. =1 in.; 944, scale 1 m. =1 in.
974. Report on Copper-bearing rocks of Eastern Townships, by J. A. Dresser. Map No. 976, scale 8 m. =1 in.
975. Report on Copper-bearing rocks of Eastern Townships, by J. A. Dresser. (French).
998. Report on the Pembroke sheet, by R. W. Ells. (French).
1028. Report on a Recent Discovery of Gold near Lake Megantic, Que., by J. A. Dresser. Map No. 1029, scale 2 m. =1 in.
1032. Report on a Recent Discovery of Gold near Lake Megantic, Que., by J. A. Dresser. (French). Map No. 1029, scale 2 m. =1 in.

NEW BRUNSWICK.

218. Western New Brunswick and Eastern Nova Scotia, by R. W. Ells. 1885. Map No. 230, scale 4 m. =1 in.
219. Carleton and Victoria counties, by L. W.Bailey. 1885. Map No. 231, scale 4 m. =1 in.

242. Victoria, Restigouche, and Northumberland counties, N.B., by L. W. Bailey and W. McInnes. 1886. Map No. 254, scale 4 m. = 1 in.
269. Northern portion and adjacent areas, by L. W. Bailey and W. McInnes. 1887-8. Map No. 290, scale 4 m. = 1 in.
330. Temiscouata and Rimouski counties, by L. W. Bailey and W. McInnes. 1890-1. Map No. 350, scale 4 m. = 1 in.
661. Mineral resources, by L. W. Bailey. 1897. Map No. 675, scale 10 m. = 1 in.
New Brunswick geology, by R. W. Ells. 1887.
799. Carboniferous system, by L. W. Bailey. 1900. }
803. Coal prospects in, by H. S. Poole. 1900. } Bound together.
983. Mineral resources, by R. W. Ells. Map No. 969, scale 16 m. = 1 in.
1034. Mineral resources, by R. W. Ells. (French). Map No. 969, scale 16 m. = 1 in.

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243. Guysborough, Antigonish, Pictou, Colchester, and Halifax counties, by Hugh Fletcher and E. R. Faribault. 1886.
331. Pictou and Colchester counties, by H. Fletcher. 1890-1.
358. Southwestern Nova Scotia (preliminary), by L. W. Bailey. 1892-3. Map No. 362, scale 8 m. = 1 in.
628. Southwestern Nova Scotia, by L. W. Bailey. 1896. Map No. 641, scale 8 m. = 1 in.
685. Sydney coal-field, by H. Fletcher. Maps Nos. 652, 653, 654, scale 1 m. = 1 in.
797. Cambrian rocks of Cape Breton, by G. F. Matthew. 1900.
871. Pictou coal-field, by H. S. Poole. 1902. Map No. 833, scale 25 ch. = 1 in.

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1042. Dominion of Canada. Minerals. Scale 100 m. = 1 in.

YUKON.

805. Explorations on Macmillan, Upper Pelly, and Stewart rivers, scale 8 m. = 1 in.
891. Portion of Duncan Creek Mining district, scale 6 m. = 1 in.
894. Sketch Map Kluane Mining district, scale 6 m. = 1 in.
916. Windy Arm Mining district, Sketch Geological Map, scale 2 m. = 1 in.
990. Conrad and Whitehorse Mining districts, scale 2 m. = 1 in.
991. Tantalus and Five Fingers coal mines, scale 1 m. = 1 in.
1011. Bonanza and Hunker creeks. Auriferous gravels. Scale 40 chains = 1 in.
1033. Lower Lake Laberge and vicinity, scale 1 m. = 1 in.
1041. Whitehorse Copper belt, scale 1 m. = 1 in.
1026. 1044-1049. Whitehorse Copper belt. Details.

BRITISH COLUMBIA.

278. Cariboo Mining district, scale 2 m. = 1 in.
604. Shuswap Geological sheet, scale 4 m. = 1 in.
771. Preliminary Edition, East Kootenay, scale 4 m. = 1 in.
767. Geological Map of Crowsnest coal-fields, scale 2 m. = 1 in.
791. West Kootenay Minerals and Striæ, scale 4 m. = 1 in.
792. West Kootenay Geological sheet, scale 4 m. = 1 in.
828. Boundary Creek Mining district, scale 1 m. = 1 in.
890. Nicola coal basin, scale 1 m. = 1 in.
941. Preliminary Geological Map of Rossland and vicinity, scale 1,600 ft. = 1 in.
987. Princeton coal basin and Copper Mountain Mining camp, scale 40 ch. = 1 in.
989. Telkwa river and vicinity, scale 2 m. = 1 in.
997. Nanaimo and New Westminster Mining division, scale 4 m. = 1 in.
1001. Special Map of Rossland. Topographical sheet. Scale 400 ft. = 1 in.
1002. Special Map of Rossland. Geological sheet. Scale 400 ft. = 1 in.
1003. Rossland Mining camp. Topographical sheet. Scale 1,200 ft. = 1 in.
1004. Rossland Mining camp. Geological sheet. Scale 1,200 ft. = 1 in.
1068. Sheep Creek Mining camp. Geological sheet. Scale 1 m. = 1 in.
1074. Sheep Creek Mining camp. Topographical sheet. Scale 1 m. = 1 in.

ALBERTA.

594-596. Peace and Athabaska rivers, scale 10 m. = 1 in.
808. Blairmore-Frank coal-fields, scale 180 ch. = 1 in.
892. Costigan coal basin, scale 40 ch = 1 in.
929-936. Cascade coal basin. Scale 1 m. = 1 in.
963-966. Moose Mountain region. Coal Areas. Scale 2 m. = 1 in.
1010. Alberta, Saskatchewan, and Manitoba. Coal Areas. Scale 35 m. = 1 in.

SASKATCHEWAN.

1010. Alberta, Saskatchewan, and Manitoba. Coal Areas. Scale 35 m. = 1 in.

MANITOBA.

804. Part of Turtle mountain showing coal areas, scale 1½ m. = 1 in.
1010. Alberta, Saskatchewan, and Manitoba. Coal Areas. Scale 35 m. = 1 in.

ONTARIO.

227. Lake of the Woods sheet, scale 2 m. = 1 in.
*283. Rainy Lake sheet, scale 4 m. = 1 in.
*342. Hunter Island sheet, scale 4 m. = 1 in.
343. Sudbury sheet, scale 4 m. = 1 in.
373. Rainy River sheet, scale 2 m. = 1 in.
560. Seine River sheet, scale 4 m. = 1 in.
570. French River sheet, scale 4 m. = 1 in.
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708. Haliburton sheet, scale 4 m. = 1 in.
720. Manitou Lake sheet, scale 4 m. = 1 in.
*750. Grenville sheet, scale 4 m. = 1 in.
770. Bancroft sheet, scale 2 m. = 1 in.
775. Sudbury district, Victoria mines, scale 1 m. = 1 in.
789. Perth sheet, scale 4 m. = 1 in.
820. Sudbury district, Sudbury, scale 1 m. = 1 in.
824-825. Sudbury district, Copper Cliff mines, scale 400 ft. = 1 in.
852. Northeast Arm of Vermilion Iron ranges, Timagami, scale 40 ch. = 1 in.
864. Sudbury district, Elsie and Murray mines, scale 400 ft. = 1 in.
903. Ottawa and Cornwall sheet, scale 4 m. = 1 in.
944. Preliminary Map of Timagami and Rabbit lakes, scale 1 m. = 1 in.
964. Geological Map of parts of Algoma and Thunder bay, scale 8 m. = 1 in.
1023. Corundum Bearing Rocks. Central Ontario. Scale 17½ m. = 1 in.
1076. Gowganda Mining Division, scale 1 m. = 1 in.

QUEBEC.

251. Sherbrooke sheet, Eastern Townships Map, scale 4 m. = 1 in.
287. Thetford and Coleraine Asbestos district, scale 40 ch. = 1 in.
375. Quebec sheet, Eastern Townships Map, scale 4 m. = 1 in.
571. Montreal sheet, Eastern Townships sheet, scale 4 m. = 1 in.
665. Three Rivers sheet, Eastern Townships Map, scale 4 m. = 1 in.
667. Gold Areas in southeastern part, scale 8 m. = 1 in.
668. Graphite district in Labelle county, scale 40 ch. = 1 in.
918. Chibougamau region, scale 4 m. = 1 in.
976. The Older Copper-bearing Rocks of the Eastern Townships, scale 8 m. = 1 in.
1007. Lake Timiskaming region, scale 2 m. = 1 in.
1029. Lake Megantic and vicinity, scale 2 m. = 1 in.

NEW BRUNSWICK.

675. Map of Principal Mineral Occurrences. Scale 10 m. = 1 in.
969. Map of Principal Mineral Localities. Scale 16 m. = 1 in.

NOVA SCOTIA.

812. Preliminary Map of Springhill coal-field, scale 50 ch. = 1 in.
833. Pictou coal-field, scale 25 ch. = 1 in.
897. Preliminary Geological Plan of Nictaux and Torbrook Iron district, scale 25 ch. = 1 in.
927. General Map of Province showing gold districts, scale 12 m. = 1 in.
937. Leipsigate Gold district, scale 500 ft. = 1 in.
945. Harrigan Gold district, scale 400 ft. = 1 in.
995. Malaga Gold district, scale 250 ft. = 1 in.
1012. Brookfield Gold district, scale 250 ft. = 1 in.
1019. Halifax Geological sheet. No. 68. Scale 1 m. = 1 in.
1025. Waverley Geological sheet. No. 67. Scale 1 m. = 1 in.
1036. St. Margaret Bay Geological sheet. No. 71. Scale 1 m. = 1 in.
1037. Windsor Geological sheet. No. 73. Scale 1 m. = 1 in.
1043. Aspotogan Geological sheet. No. 70. Scale 1 m. = 1 in.

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Canada
Department of Mines
GEOLOGICAL SURVEY
Hon. W. Templeman, Minister. A. P. Low, Deputy Minister.
R. W. Brock, Acting Director.
1910.

EXPLORATIONS

NORTH WEST TERRITORIES

DESCRIPTIVE NOTES

PHYSIOGRAPHY.

The Mackenzie mountains occupy the greater part of the area represented on the map and form a divide between streams flowing into the Arctic ocean and streams flowing into Bering sea. They are regarded as a northern member of the Rocky Mountain system and have a maximum width of about 300 miles, measured along the Macmillan and Gravel rivers. They extend for about 700 miles northwesterly from Liard river almost to Porcupine river. The Mackenzie system has resulted from long continued, differential erosion acting on an uplifted, deformed area now represented by a complicated group of irregular ranges with numerous peaks rising to heights of between 6,500 and 7,500 feet above sea-level.

East of Mount Sekwi, on Gravel river, the mountains differ in form, structure and colour from those to the west of that point. The western portion of the system has been subjected to long continued erosion, the valleys are wide with forest covered slopes rising in easy curves, and the higher peaks are set well back from the valley bottoms. In the eastern portion the mountains are evidently in a more youthful topographic stage; they are more massive and rugged, and the drainage channels are confined in narrow valleys having steep, barren or partly wooded slopes of rock and talus.

The region lying west of the Mackenzie mountains between the lower portions of Ross and Pelly rivers, is one of comparatively low relief, the hills having a general elevation of about 5,000 feet above sea-level or of 2,000 feet above the levels of the principal rivers. The region is characterized by long, gently sloping, irregular hills covered almost to their summits with a thin growth of small spruce and balsam and the main rivers and their chief tributaries occupy extensive, well developed valleys. These valleys have fairly level floors, often several miles in width, and contain many small lakes and ponds, also extensive beaver meadows and groves of good spruce. This type of country occupies a belt extending southeasterly from the Pelly mountains, [illegible] isolated, high groups, to the Mackenzie mountains.

The high ranges of the Mackenzie mountains on their eastern side along the Gravel river, are succeeded, 50 miles from the Mackenzie river, by a belt of foothills about 3,000 feet in height above sea-level. Eastward the foothills decline in height and finally terminate in a broken, wooded plain, bordering the Mackenzie river, with an elevation of about 600 feet above sea level.

The western slopes of the Mackenzie mountains are the gathering ground of numerous streams that flow into the Pelly, Macmillan and Ross rivers, tributaries of the Yukon. A small portion of the drainage of the western slopes in the area shown near the southern border of the map, flows into Frances river which joins the Liard, a tributary of the Mackenzie. The drainage of the eastern slopes of the system is received by the Mackenzie river. On the western slopes, where the precipitation is heavy, the streams meander through wide, well developed valleys having easy grades. On the eastern side, where the precipitation is light, the drainage channels are contracted and are confined in narrow valleys with steep grades.

The Pelly river during high water, is navigable by small steamboats from the Yukon to the mouth of Ross river, a distance of 260 miles. The Macmillan is navigable as far as the forks, 158 miles from the Pelly. Small boats or canoes can be poled or tracked up the Pelly for at least 180 miles from the mouth of Ross river with portage at Hoole and Wolf cañons. On Ross river, Sheldon lake is the limit of boat navigation when the water is low but in high stages, John lake or even Wilson lake, may be reached. Below Lewes lake there is a stretch of 20 miles of swift water, with four short rapids past which goods are portaged. The Gravel river may be descended by boat from Twitya brook to the river mouth, preferably at high water but it is practically impossible to take a loaded boat up river.

GEOLOGY.

The rocks thought to be the oldest in the region and which are regarded as pre-Ordovician, occur along the part of the Pelly river shown in the southwestern corner of the map. They seem to be confined to this area and do not appear to the north though found to the southwest on Finlayson river. While certain altered intrusions and volcanics are present, the rocks are mainly of sedimentary types but largely altered, having a crystalline texture and a schistose structure. Quartz-mica schists of a dark grey or greenish colour are the commonest varieties and all the rocks are cut by quartz veins and stringers.

The Mackenzie mountains are made up mainly of sedimentary rocks including shales, slates, cherts, sandstones, conglomerates, limestones and dolomites. They are all of Palaeozoic age, ranging from Upper Cambrian to Middle Devonian. The greater part of the area extending from the Pelly valley to Mount Sekwi on the Gravel river, is underlain by shales and slates, accompanied by quartzites and a highly indurated, bedded rock referred to as a chert. Graptolites of Upper Ordovician age were found in black shales on Ross river about five miles below John lake. A band, several miles wide, of sandstone, fine quartz conglomerate, quartzite and limestone, crosses Pelly river in the vicinity of Wolf cañon and, extending in a northwest direction, crosses Ross river at Prevost cañon and Macmillan river near the forks. A band of similar rocks crosses Stewart river at the Tasin mountains. These rocks are supposed to be of later date than the graptolite bearing shales of Ross river and may be Silurian. Chert breccias, overlying slates and cherts, form the greater part of some of the high mountains of the Selwyn range, and a few beds of the same material aggregating about 20 feet in thickness, overlie slates at Slate rapid on Pelly river. The sedimentary rocks, at various points, are intruded by small bodies of igneous rocks. A number of higher mountain peaks are known to be composed of granite and doubtless many other high peaks and mountain groups owe their height and ruggedness to this cause.

The strata of the western portion of the Mackenzie mountains have, though with many minor deviations, a general northwest strike and dip at various angles either to the northeast or southwest. As a whole, they are broadly folded but in places the folding is close. There is evidence of faulting, and the repetition of similar beds with, over long distances, the same inclination, may be due to overturned folds.

The geology of the eastern portion of the Mackenzie mountains, from Mount Sekwi on Gravel river to the foothills of the Mackenzie, differs in many respects from that to the westward. Heavily bedded limestones, dolomites, sandstones and conglomerates, mostly weathering to bright colours, are the prevailing rocks. Cambrian, Ordovician and Devonian fossils were found at a number of localities. Of the fossil forms found, the most interesting probably is Billingsella Coloradoensis, indicating a Middle or Upper Cambrian horizon. In the eastern region, igneous rocks were found only at one locality where, below the mouth of Twitya river, a sill of diabase, about 100 feet thick is intruded in sandstone.

The strata of the eastern portion of the Mackenzie mountains have generally a northwesterly strike, the prevailing dip being southwesterly. Faulting and tilting of the strata has given the mountains their characteristic forms and in many respects they resemble the Rocky Mountains of southern Canada.

The region of lower elevation bordering the Mackenzie is underlain by small detached areas of Mesozoic rocks of Upper Cretaceous and Tertiary age. These rocks are principally soft sandstones, shales and conglomerates; the beds are either horizontal or gently undulating. The Tertiary beds contain several seams of lignite.

ECONOMIC NOTES.

Indications of the presence of minerals of economic interest are rare within the traversed portion of the Mackenzie mountains. A bed of iron ore was seen on Gravel a few miles below Shezal cañon. The ore bed outcrops from beneath a thick mass of conglomerate which extends for about 20 miles north of Mount Dellhore. The associated rocks dip south; their age is unknown but they probably underlie Upper Cambrian rocks exposed in the mountains near Natla river. The following is a section in descending order of the strata in the neighbourhood of the ore outcrop:—

Brown, micaceous sandy slates	1,100 feet
Conglomerate	2,000 „
Hematite, coarsely laminated with red siliceous slates	100 „
Grey, compact dolomite	1,000 „

In 1875 the gravel bars at the mouth of Finlayson river were worked for gold and yielded pay at the rate of $4. to $8. a day. In its distribution the placer gold is found to be confined to the area underlain by the crystalline schists, that lie along the Pelly and Finlayson rivers. Alluvial gold is almost always present in the stream gravels within this area. The country has been heavily glaciated and it is probable that much of the gold that existed on bedrock during pre-glacial times has been distributed in the glacial drift. The fine flaky gold which enriches the river bars, has been derived from this drift by the concentrating action of streams. Fine gold has been found in the gravels of Pelly river from Campbell creek to the Yukon, and on most of the small streams entering from the south. No coarse gold on bedrock has been found in this region. The best bars on the Pelly are between Hoole cañon and Hoole river. On the portion of the bars where the gold is concentrated, it is possible, with proper appliances, to wash out about $3. a day, but the enriched portions of the bars are shallow and of limited extent.

No. 1099

PELLY, ROSS AND GRAVEL RIVERS

YUKON and NORTH WEST TERRITORIES

8 MILES TO 1 INCH

SOURCES OF INFORMATION

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To accompany Report No. 1097 (English) and No. 1098 (French)